MAR 13 1934

Engineering News-Record

March 8, 1934

For Constructive Action

FOUR MILLION MEN are being released by the Civil Works Administration; the process has already begun. Some of them will be absorbed by industry and public works, but the large majority will have to go back on relief. As a result, unemployment is due to rise sharply and the recovery program is in danger of a setback.

• Such disastrous consequences cannot and need not be allowed to follow the necessary curtailment of the CWA system. Prompt constructive action on the four-billion-dollar pool of PWA projects now pigeonholed at Washington for lack of funds can provide these released men with jobs and save the public-works movement as a recovery measure.

• But it is necessary that the President and Congress establish a new public-works fund adequate to mobilize these projects. In addition, red tape must be cut, to make quicker contract letting possible. The speed of the CWA system can thus be combined with the productive and public welfare value of the PWA projects. The President can save the recovery movement, and at the same time he will have kept faith with the country that brought forward the projects in response to his appeal.

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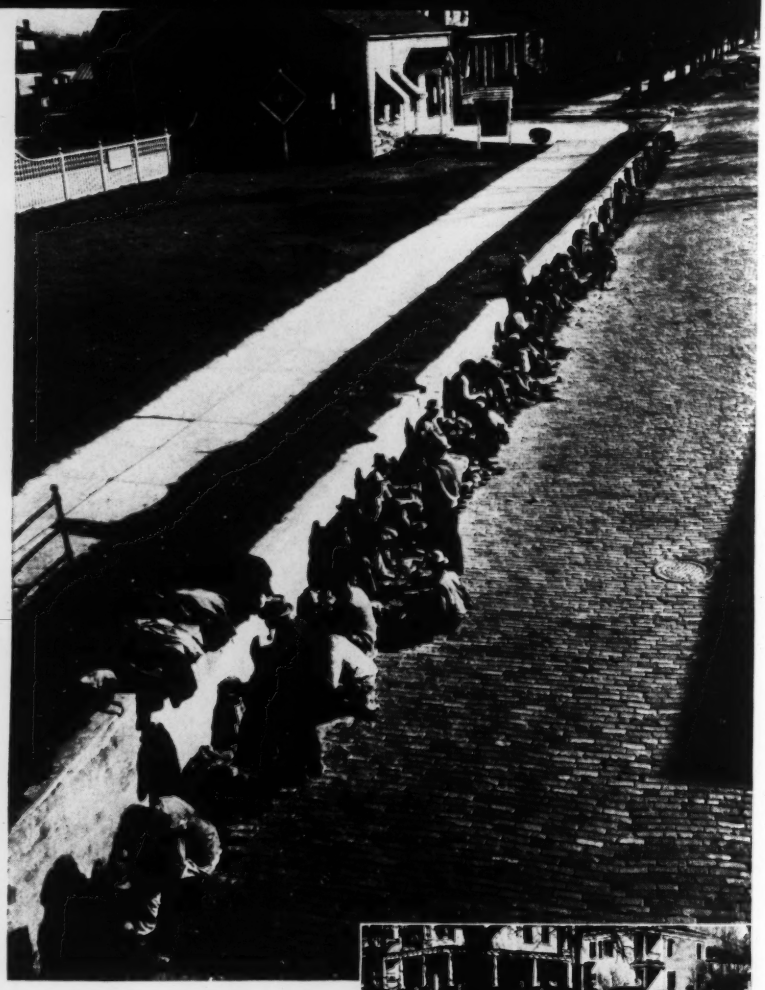

● *Relief labor breaking up brick of old pavements in Savannah, Georgia. Mixed with crushed rock, the broken brick made up the aggregate for the new cement bound macadam streets*

● *Form Setting and Subgrading—Henry St., Savannah, Ga.*

● *Rolling before grouting, and grouting in the foreground, in a widening project, Borough of Richmond, City of New York*

● *Grout is mixed and distributed through perforated chute—Staten Island, New York*

● *Measuring Sand—Savannah, Ga.*

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In the News:

THE PRESIDENT has asked Congress to guarantee the principal of home-loan bonds to the amount of two billion dollars. Farm mortgage bonds in the same amount are now guaranteed. Originally only the interest of both these types of securities was guaranteed by the federal government. It is also proposed that the Home Owners Loan Corp. lend money for modernization and repair work. The date of the President's message was March 1.

MICHIGAN LEGISLATORS are considering seriously a $30,000,000 state bond issue as an emergency fund to relieve unemployment. All this money is planned for construction and about half of it for grade-crossing elimination.

MORE THAN three-fourths of the $400,000,000 highway program is either under construction by day labor or advertised for contract. As of Feb. 24, 125,000 men had been given direct employment. On the average, states have awarded contracts for two-thirds of their federal allotments.

FIRST-AID STATIONS for passing motorists are being planned at 10-mile intervals along the 350-mile Kings Highway between Toronto and Montreal. The Canadian Red Cross is assisting, and the stations, in garages or private homes, will be supervised, in Ontario at least, by the highway patrol, according to a despatch to the *New York Times*.

WHEN the CWA system goes out of existence there will be a new relief agency ready to take its place. In addition to jobs for the urban unemployed, help will be extended to farmers in repairing homes and buildings and in buying seed, also to families stranded in towns whose industries have ceased to exist. President Roosevelt announced this plan last week, to utilize the half-billion appropriation made by Congress.

In This Issue:

RELOCATING a mile of the old Cumberland Pike, built more than a century ago, is a recently completed job of the Ohio state highway department. Included in the work is a new high-level viaduct paralleling the old masonry-arch bridge over Wheeling Creek, which has served Conestoga wagons and Concord passenger coaches as well as modern trucks, buses and motor cars.

ONE OF THE GREATEST river-improvement projects of the world is represented by the current program of building 27 lock-and-dam structures on the upper Mississippi River to provide a 9-ft.-deep navigation channel. The novel roller-gate type of dam will be utilized. Four lock-and-dam structures are complete, and work is under way on fifteen others.

A LANDSLIDE in which dry and not saturated material was involved is now characterized as the unique type of earth movement that caused the disastrous wreck on the R.F.&P. Railroad in Virginia last November.

COPPER SULPHATE used in water reservoirs for algæ control occassionally passes through filtration plants into a city water supply. Some new tests indicate it can be removed by alum coagulation, so long as the pH of the filtered water remains above 6.3.

DR. TERZAGHI continues his discussion of large-model retaining-wall tests with a consideration of submerged fine-grained soil backfill.

THE SERIES OF ARTICLES on problems of contracting is resumed with Mr. Harrison's discussion of surety bonds and insurance.

WORK is to begin soon on a second vehicle tunnel under the Hudson River at New York. The PWA is furnishing the money, and the Port of New York Authority has designed and will construct it. Details of the structure, its location and approaches, in so far as they have been fixed, are given in this issue.

Coming Articles:

A NOTABLE BEGINNING of the $124,000,000 project for canalizing 650 miles of the Mississippi River has been made by the completion of dual locks and the world's largest roller-gate dam at Rock Island, Ill. The two parts of this great structure, dual locks and roller-gate dam, will be described in our issues of March 15 and March 29. A subsequent issue will review navigation-dam practice on American rivers with special reference to roller-gate dam development and design. These articles will present pictorially and descriptively the greatest change of half a century in river canalization practice in America.

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ENGINEERING NEWS-RECORD

New York

March 8, 1934

FIG. 1—RELOCATION of old National Road near St. Clairsville, Ohio, showing new high-level viaduct over stream and railway and stone arch of old road constructed in 1826.

Realignment of Old National Road

More than a mile of road near St. Clairsville, Ohio, laid out in 1826, relocated to reduce curvature—High-level concrete-arch bidge carries new road over river and railway

By C. C. Brooking

Resident Engineer, Ohio Department of Highways, Bellaire, Ohio

CROSSING elimination and highway-straightening operation of more than local interest and involving an expenditure of $306,000 on a little more than a mile of highway has been carried out during the last twelve months by the Ohio department of highways. This work was located about 3 miles east of St. Clairsville, Ohio, which is almost directly west of Wheeling, W. Va., a few miles across the Ohio River. It was a revision of a part of the Cumberland or National Road, one of the great highways of history, and this part was built in 1826. Since being built, the old location had remained and the old structures, one of which is shown in the first illustration, had served the Conestoga freight wagon and Concord passenger coach as they are still serving the automobile and motor truck.

Old and new road

The old road location, as shown by Figs. 1 and 2, was crooked, and since its construction (which antedated the railway) a railway had been built which created a grade-crossing at low level. In 1914 the old road in the stretch being considered was paved 16 ft. wide with brick and 6-in. concrete curbs. But no material change was made in alignment and structures except to repoint the old stone masonry. In profile the road was up and down hill into and out of the valley of Wheeling Creek. To accomplish a road-rail crossing improvement on the old location necessitated raising the old stone arch bridge. Considering this fact and the line and profile, a complete relocation and a new bridge were decided on, leaving the old road and bridge to serve as an access road for the settlement along the railroad and creek.

The new location in respect to the old is shown by Fig. 2. It included 1.457 miles of road in which was a viaduct 1,118 ft. long. This more than a mile of new road has ten curves with a total curvature of 226 deg. and a minimum radius of curve of 520.78 ft., or 11 deg. The old road had 21 curves with a total curvature of 1,196 deg. and radii varying from 53.71 to 143.24 ft. Little was saved in maximum grade (7.88 per cent old, 7.36 per cent new) but length was reduced 670 ft. The grades on the new road are shown on the profile on Fig. 2.

The road structure

The roadway is 49 ft. wide and is paved 30 ft. wide with 10:8:10-in. concrete. A concrete gutter 4 ft. wide was constructed in the cuts. The maximum center-line cut and fill is 50 ft. However, the cut slopes, 1 on 1, extend as far as 125 ft. from the center line due to the slope of the present ground.

The viaduct consists of five reinforced-concrete girder spans from 37 to 46 ft. c. to c. of piers; one incased steel-girder span over the B.&O. R.R., 46 ft. long, and four reinforced-concrete arches of lengths c. to c. of piers 146.5, 132.5, 118.5 and 103.5 ft. The height of the span over Wheeling Creek from low water to roadway level is 89 ft. To take

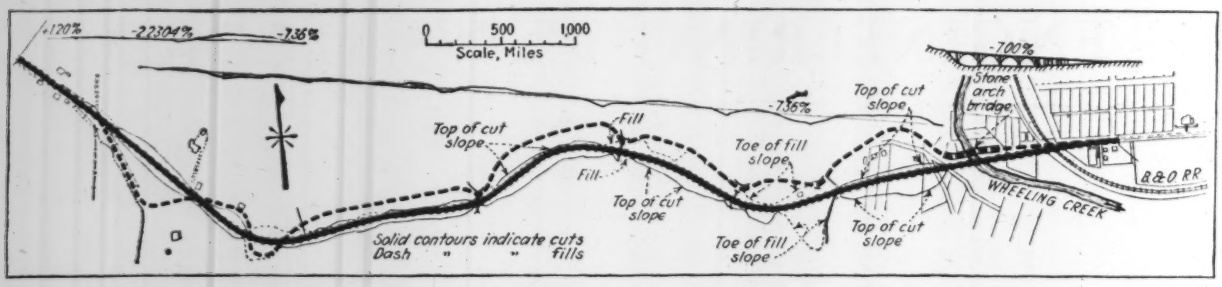


FIG. 2—LINE and profile of relocation of old National Road, reducing the curvature 970 deg. and eliminating a railroad grade-crossing.

care of a county side road and minimize property damage east of the B.&O. Railroad, a retaining wall from 6 to 30 ft. high and 226 ft. long was built on each side of the roadway. A shale fill from the hill was placed between the walls to carry the roadway. The viaduct roadway is 34 ft. wide with a sidewalk on each side.

As will be seen from plan and profile, the major construction operations were two heavy cuts and the viaduct. The quantities included about 266,000 cu.yd. (⅓ rock) on the grade and about 6,500 cu.yd. for the bridge foundations. The concrete paving ran about 23,300 sq.yd., and the concrete in bridge and walls about 8,000 cu.yd. The viaduct required about 31 tons of structural and 466 tons of reinforcing steel. Railings, gutters, drains, etc., increased these quantities.

Both the grading and bridge work were adequately equipped by the contractor. In the big cuts well-drills were used. On the cut at the hill top at the west end of the line the contractor drilled holes 20 ft. c. to c. and to the total depth of the cut, which was as much as 40 ft. These holes were filled to the top with carbon sticks, dipped in liquid oxygen; a cordite fuse or cord was placed the full length of the hole and capped, and four holes were fired at once. No earth and rock was thrown from the right-of-way in shooting, and no windows were broken in a large inn that was located only 220 ft. from the center line of the road. This cut was composed of 10 ft. of earth and from 20 to 30 ft. of shale in which there was a 4-ft. layer of very hard seamed sandstone. The shots penetrated to the full depth of the holes, and all rock except the sandstone was well broken up, but the force of the explosion followed the seams in the sandstone and did not break it up. However, the shooting was well worth while in loosening the shale, which facilitated handling with the shovels.

The cut just west of the viaduct, the largest cut on the project, contained 90,000 cu.yd., and had a center-line depth of 25 to 50 ft., a vertical upper-slope cut of 90 ft. and contained about 70 per cent rock—mostly shale, cement rock and limestone. This cut was first excavated to the rock, which was about 15 ft. below the surface, and then drilled with the well drill and shot as described. However, upon being shot the rock was scattered over 200 ft. from the center line and the shot did very little to break it up, the force of the explosives following the rock seams. Several shots were fired, but with the same results; and since the roofs of four homes located 150 ft. from the center line were damaged, this method was abandoned.

An air compressor was secured and 8½-ft. holes were drilled and shot first with black powder, with dynamite and finally with yellow powder. This yellow powder apparently was the most easily controlled, and with dynamite in small quantities it was used for completion of blasting in this cut.

All except 20 per cent of the hauling was done with 1½-ton trucks, and this 20 per cent was done with crawler tractors and 6-cu.yd. gravity dump wagons, which were fairly successful in mud and on short hauls, their greatest fault being that the 30- and 35-hp. tractors were not large enough to operate them efficiently.

Excavating for the footers of the bridge was done by shovel or crane equipped with a clamshell bucket. Steel sheetpiling was driven to rock to form a cofferdam for each pier footer and was then excavated with the clam to rock. The rock was broken up by blasting, and it was removed by hand labor and clam. Shoring was not necessary below the bottom of the steel piling, and no slides or cave-ins occurred during the placing of forms and the pouring of the concrete in the footers. Except for the pier footer in the channel of Wheeling Creek, the water was

FIG. 3—CUT AT TOP OF HILL at west end of relocation, showing new concrete pavement.

FIG. 4—COMPLETED ARCH RIBS of new concrete viaduct with deck construction in progress at one end.

easily pumped away, and this pier footer was not especially difficult to keep free from water. All footings were placed on rock except the two piers west of the B.&O. Railroad, in which reinforced-concrete pipe piles were used to avoid underpinning the B.&O. roadbed.

Timber was used for all falsework. It was necessary to drive timber piling to support the falsework and forms for the arch ribs. This method was very successful since the greatest deflection on any arch rib was less than ¾ in., and this settlement was probably not a direct settlement of falsework but rather deflection, due to the pouring of concrete. The ribs were poured in three pours; first the haunches of the arch were poured, then the top center, and lastly the two sides of the ribs. For the most part the deck was supported by falsework placed on the arch ribs. This method was very successful since the railing line on both sides is perfect.

The aggregates for concrete work were batched 10 miles from the job and hauled in trucks to the mixer. All aggregates were heated at the plant when the temperature was below 50 deg. F., and hot water was used at the mixer. In all work below the ground level the concrete was chuted in place, but above the ground level it was hoisted by a crane in buckets to a bin and chuted or buggied into place. About 100 cu.yd. per eight hours was placed in this manner, which required seven trucks hauling to the plant.

The project is a part of the emergency federal-aid program under Director O. W. Merrell, of the Ohio State Highway Department. It was designed by the bureau of bridges and built by the Hecker-Moon Co., Cleveland, Ohio, at a cost of $306,000, Belmont County and the B.&O. R.R. Co. participating in the cost. The hill was sublet to Springer & Springer Construction Co., Wheeling, W. Va. B. J. O'Connor was superintendent for the contractor on the viaduct, and Howard Springer was superintendent for the subcontractors. The writer is resident engineer for the Ohio state highway department.

Second Vehicle Tunnel to Be Built at New York

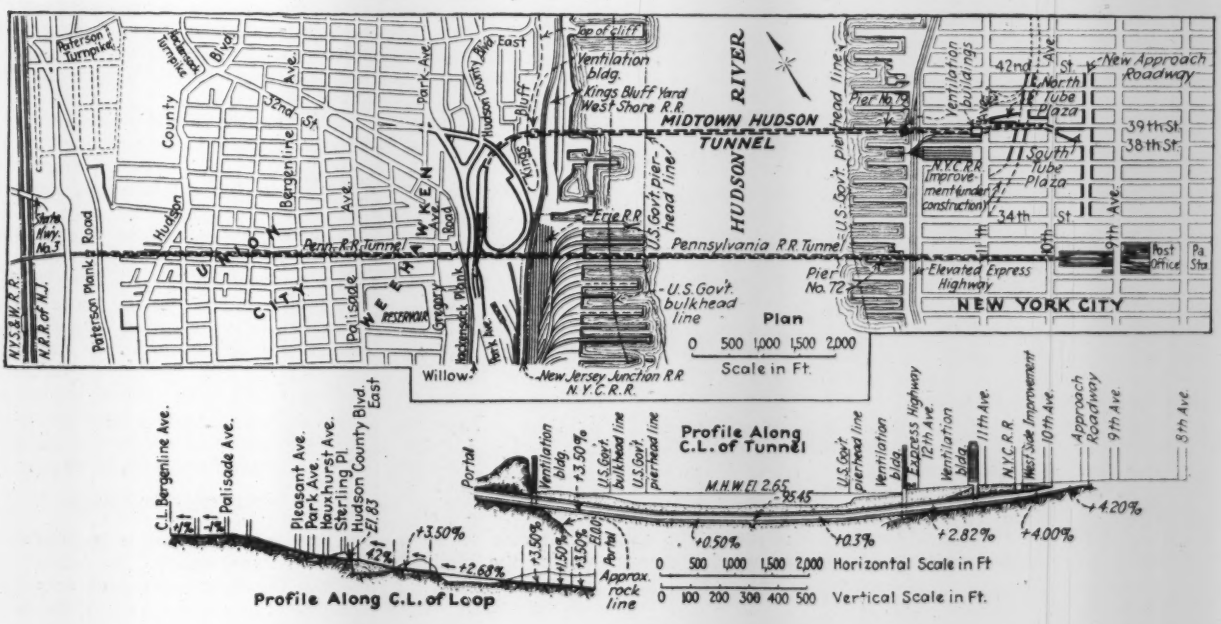
Bids have been received and a contract is to be let soon for the under-river section of one tube of a projected two-tube tunnel under the Hudson River at New York

ACTUAL CONSTRUCTION on a second vehicle tunnel under the Hudson River at New York is expected to be under way within a few weeks, bids having been opened on Feb. 21 for construction of the under-river section of the south tube of the Midtown Hudson Tunnel, a two-tube tunnel extending from the neighborhood of West 39th St. on Manhattan Island to Weehawken and Union City in New Jersey. (The amount of the bids received was published in our issue of March 1, p. 304.)

The Midtown Hudson Tunnel is to be built by the Port of New York Authority as its third highway crossing of the Hudson River at New York, the Port Authority having built the George Washington Bridge and having had the Holland Tunnel turned over to it for maintenance and operation subsequent to its completion.

The new vehicle tunnel, located about midway between the wide cross-town thoroughfares of 42d and 34th Sts., is to provide the industrial and commercial establishments in the midtown section with more direct connection with the railroad terminals and main highways in New Jersey.

The accompanying drawing shows the location of the south tube of the proposed tunnel, the one now under construction, the approved layout of the New York approaches and a tentative approach layout at the New Jersey end. The New Jersey approach layout is complicated by the fact that the land rises sharply back of the railroad yards along the riverfront, ultimately reaching a



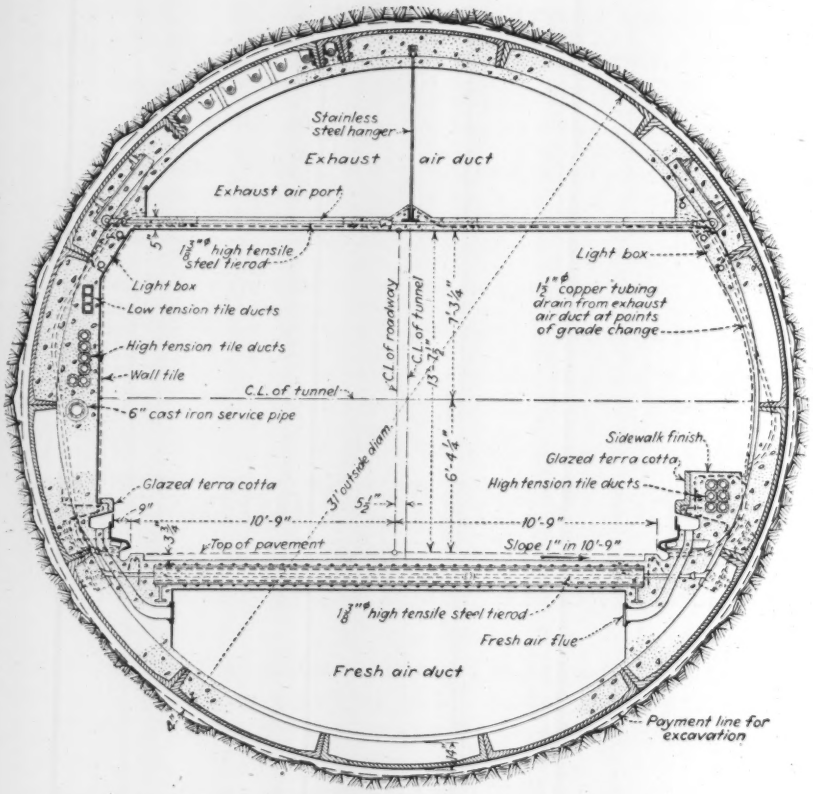
level nearly 200 ft. above the river in Union City, and then falls again to the Hackensack Meadows. In the plan for this tunnel prepared about three years ago it was proposed to bring the roadways to the surface back of the waterfront and then continue the tunnels through the hill to connections with the highways along the Hackensack Meadows. In the plans now under discussion it is proposed to carry the tunnels through a spur known as Kings Bluff to a side valley back of the bluff. There connections will be made to streets serving the waterfront and, by a long loop, height will be gained for connections with streets on the high land. One proposal being considered calls for continuing the approaches in a depressed roadway across Union City to connections with the state highway system.

At the New York end a new street about midway between 9th and 10th Aves. is to be cut through from 34th to 42d St., and the greater part of the west end of the block between 38th and 39th St. will be used for a plaza descending to the tunnel level. For the present this will be used for both eastbound and westbound traffic through the south tube.

Between 10th and 11th Aves. the New York Central Railroad is now building a subway connecting its 30th St. yards with its 60th St. yards. The south tube, the one now under construction, will pass under this subway in 39th St. When the north tube is built, it will not pass under this subway but will come to the surface west of the subway between it and 11th Ave., with an entrance plaza in the block between 39th and 40th Sts. The New York Central subway will be decked over between 37th and 42d Sts. to provide approach streets. When the north tube goes into service as a westbound tube, this new street over the New York Central tracks will be given over entirely to westbound traffic from both the north and south, and the streets presently to be cut through between 10th and 9th Aves. will be given over entirely to eastbound traffic from the south tube.

The maximum grade in the tunnel is 4 per cent for a short distance between the points where the tunnel passes under the new New York Central subway west of 10th Ave. in New York and the plaza between 9th and 10th Aves. In the open plaza the grade is increased to 4.2 per cent. Otherwise, the grade at the New York end is 2.8 per cent and the grade at the New Jersey end is 3.50 per cent. The grades shown above are tentative and may be revised downward before construction begins.

In general arrangement the tunnel is similar to the Holland Tunnel. The diameter, however, is somewhat larger, 31 ft. to outside of shell, instead of 29 ft. 6 in. in the Holland Tunnel. This permits of a somewhat wider roadway, 21 ft. 6 in. as compared with 20 ft. in the Holland Tunnel. A 9-in.-wide curb adds to the apparent width of the roadway. There is a clear headroom of 13 ft. 7½ in. The larger tunnel diameter also makes it possible to devote more space to the air ducts above and below the roadway, thus simplifying the ventilation problem. The new tunnel will have three ventilating shafts instead of four, as on the Holland Tunnel, and there will be no ventilating shafts at the pierhead, as in the older tunnel.



TYPICAL CROSS-SECTION of the Midtown Tunnel, in earth. Where the tunnel is in rock all tierods will be omitted, and where the lower part is in rock the lower tierods will be omitted.

A contract for supplying 51,800 tons of cast-iron and cast-steel lining was let to the Bethlehem Steel Corp. on Oct. 19 on a bid of $2,358,150. Of this total, 3,300 tons is for cast-steel segments for use at points where the tunnel joins the ventilation shafts and at the location of the mid-river sump. On Dec. 5 a contract for supplying 346,000 high-tensile steel bolts was let to the Oliver Iron & Steel Corp., Pittsburgh, for $177,664.

The lining contract requires that segments for at least 200 rings must be complete and ready for shipment by March 1, and that thereafter not less than 200 rings a month must be ready for shipment, all shipments and special castings to be complete by Jan. 1, 1935. Actual delivery may extend over 27 months. The contractor already is up to full production on the lining segments. The same contractor supplied some of the segments for the Holland Tunnel.

The greater part of the tunnel work under the present contract will be by the shield method under compressed air. The contractor is required to carry on his tunneling operations in both directions simultaneously, one shield moving west from the New York construction shaft and the other east from the New Jersey ventilation shaft.

The work yet to be put up for bid, the land sections of the tunnel at both ends, is in rock and will be by normal rock-tunneling methods or open-cut subway construction.

In driving the tunnel under the river, the contractor will be permitted to deposit a clay blanket over the tunnel for protection during construction, but this blanket must be removed after it has served its purpose, and the river bottom restored to its former condition.

Grouting of the space left behind the shield used in driving the tunnel is to be carried on progressively directly behind the shield in order to minimize settlement. The use of pea-gravel packing is permitted where the tunnel shield is through earth or part earth and part rock, provided the pea-gravel packing is followed by cement grout.

Ventilation buildings

Three ventilation shafts and buildings are called for, one at the face of the cliffs at the New Jersey end, one at the bulkhead line on the New York shore,

and one just west of 11th Ave. The New Jersey ventilation shaft, which will form the foundation, basement, subbasement and the lower portion of the pier ducts of the New Jersey ventilation building, will be a steel and reinforced-concrete structure constructed in an excavation in rock. The New York ventilation shaft, known as the river shaft, will form the foundation for one of the New York ventilation buildings. It is included in the present contract and is to be constructed by means of a steel and concrete pneumatic caisson. Superstructures are not included in the present contract. The shaft for the other New York building will be in rock.

The present contract requires, in addition to the ventilation shaft, the construction of temporary shafts on both sides of the river known as construction shafts. The one in New York will be on the south side of 39th St., 165 ft. west of 11th Ave., where the contractor will start his New York tunnel operations. The construction shaft in New Jersey will not be built until after the shield has progressed to a point east of its location. These construction shafts are for the use of the contractor in carrying on his tunneling operations, as he will not be permitted to use ventilation shafts after their completion except to a limited extent. West of the New Jersey ventilation shaft the present contractor must drive the tunnel in rock for a distance of 90 ft. from the center line of the shaft.

Under the present contract the work on the New Jersey ventilation shaft and the New York river shaft and all work west of the New Jersey shaft are to be completed by July 1, 1935, and work within the tunnel is to be completed to the point where the electrical wiring and equipment, the tunnel fittings and tunnel pavement can start on or before Jan. 1, 1937. The entire contract is to be completed on or before March 1, 1937. It is expected that the tunnel will be completed ready for service early in 1938.

Personnel

Construction of the tunnel is being carried forward by the Port of New York Authority, with Commissioner Alexander J. Shamberg as chairman of the tunnel committee. O. H. Ammann is chief engineer, Edward W. Stearns assistant chief engineer, Ralph Smillie engineer of design, W. E. Thompson tunnel engineer, and Charles S. Gleim engineer of construction. Both Mr. Smillie and Mr. Gleim took part in the construction of the Holland Tunnel. Ole Singstad is chief consulting engineer on tunnels, and Robert Ridgway and James Forgie are tunnel consultants.

The present work is being financed with a loan of $37,500,000 from the Public Works Administration. Arthur S. Tuttle, as state engineer for the PWA, will have supervision of the tunnel work.

Vibration Meter for Earthquake Studies of Buildings

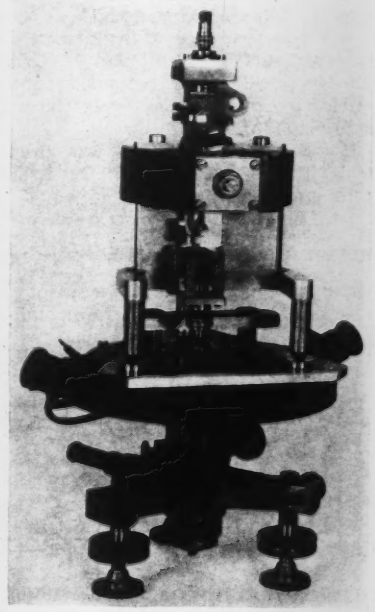
By N. H. Heck

Chief, Division of Terrestrial Magnetism and Seismology, U. S. Coast & Geodetic Survey, Washington D. C.

THE VIBRATION METER, development of which was recently announced by the Coast and Geodetic Survey, differs from any previously developed instrument for this general purpose in several particulars. It is for the purpose of observing vibrations in buildings in which earthquake effects are being studied. The need for it arose from the difference in earthquake records at the top and bottom of tall buildings and from the necessity for correlating them.

The vibration meter as fitted for visual operation (observing the movement of a light beam on a scale, and measuring its period by stopwatch) is a portable instrument. When fitted for recording on photographic paper and more accurate time control, it can with some modifications be substituted for the accelerometers of the strong-motion accelerograph (*ENR*, Sept. 8, 1932, p. 288), in which case the total apparatus weighs about 150 lb. When instruments enough are available (this is not now the case), observations can be made at several stories of a building, and simultaneous time marks can be recorded on all the drums by aid of a recent device.

Most instruments that have been used for measuring building vibrations have a very long or very short period, but this one has a period of 1.5 sec., which is within the range of earthquake periods generally considered destructive to buildings and also within the range of natural vibration periods of buildings. The vibration meter belongs to the type of instrument that includes the Wood-Anderson seismometer and the Wenner accelerometer. In fact, it is a modification of the latter, made with the advice of Dr. Frank Wenner, of the Bureau of Standards, who developed the accelerometer.



PORTABLE vibration meter for buildings recently developed by Geodetic Survey for earthquake studies.

In these instruments the steady mass in most cases consists of a rectangular loop or vane of copper, one of the long sides of which is rigidly attached to the suspension and the other moves in the field of a magnet to produce the desired degree of damping. When horizontal movement is to be recorded, the suspension is vertical or nearly so, and, if of wire as in the vibration meter, the suspension is under tension. The restoring force (which tends to bring the vane back to its initial position when disturbed) is produced by torsion of the wire for short periods and by both torsion and gravity for longer periods, the gravity action being introduced by tipping the suspension slightly out of the vertical. Since a single wire suspension is used, it is necessary to get rid of so-called violin-string vibration in the wire by passing it through holders containing each a drop of oil held in place by capillary attraction.

The magnification is optical, and may be varied by altering the distance of the recording surface from the instrument; magnifications from 200 to 300 are readily obtained. Critical damping is used.

The instrument has not yet been used for earthquake studies but has been tested by measuring the vibrations of a tall building in Baltimore during a 30-mile (average) wind. The amplitude of the vibrations was very small, but there was no difficulty in obtaining the period. The periods were measured in both directions of the building and, as a matter of interest, at 45 deg. with these directions, the movement in the latter direction lacking the well-defined characteristics of those in the prime directions but showing a period halfway between the others.

The present program of the Coast and Geodetic Survey does not go beyond using such an instrument in the few buildings in which the bureau has installed accelerographs at top and bottom. Observations can be made only during light earthquakes or high winds, but they could be made at any time if a device for putting the building into controlled vibrations were available.

LARGE RETAINING-WALL TESTS

III—Action of Water Pressure on Fine-Grained Soils

A series of five papers reporting fundamental results

As with submerged sand, the retaining wall backfilled with fine-grained soil such as till or clay receives full water pressure plus the pressure of the solid fraction of the fill

By Karl Terzaghi
Professor, Technische Hochschule, Vienna, Austria

FOR coarse-grained materials, such as sands, the tests of H. de B. Parsons[1] and of many others have conclusively demonstrated that hydrostatic uplift is fully active. As a consequence, within a submerged mass of such material the water acts on every plane as if the sand were not present. This result of the Parsons tests was to be expected, yet to many engineers it came as a surprise and was accepted only with reluctance by some. Therefore the question of hydrostatic uplift in fine-grained materials, such as clay or cement-mortar, must be considered a delicate and controversial topic.

No water can penetrate into bodies that have no voids, such as metals or glass, and in such materials no hydrostatic uplift can occur. On the other hand, in coarse sand the area of contact between the grains is negligible compared with the total surface of the grains. Therefore the weight of each grain is reduced by practically the full hydrostatic uplift. In materials intermediate between these two extremes, where the grains are cemented together, the cement forms solid bridges from grain to grain, and hydrostatic forces cannot act at those parts of the surfaces of the grains that are occupied by the cement. Hence the total effect of the hydrostatic pressure on the granular material depends on the relation between the area of the cement spots and the total internal surface of the substance.

Coefficient of grain contact

Fig. 1 shows a magnified section through a submerged mass of very fine-grained material, in intimate contact with the horizontal floor and the vertical side of a solid body. The areas at which the grains are cemented together or cemented to the surface of the solid body are shown black. The curved line $S_1' S_2'$ is a section which follows an arbitrary plane section $S_1 S_2$ as closely as possible without cutting the grains. Such a section as $S_1 S_2$ will be designated as a "contact section." Concerning the areas of contact, we make the following assumption: The projection of the areas where the curved surface

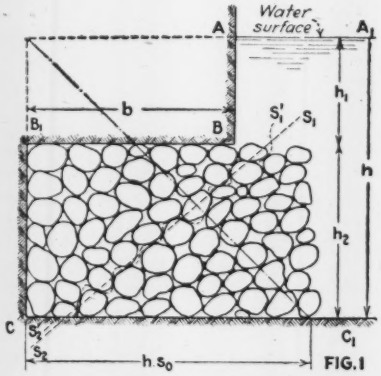


FIG. 1—DIAGRAM representing the condition of partial cementation which affects the computation of hydrostatic pressure and uplift in fine-grained soils.

$S_1' S_2'$ cuts through the films of cement upon the coordinated plane $S_1 S_2$ is equal to m per units of area of this plane. The inclosing surfaces $B B_1$ and $B_1 C$ are also supposed to be cemented to the adjoining granular mass over the area m per unit of surface.

If the granular material was absent, or if it consisted of sand, the hydrostatic uplift acting on $B B_1$ would be $V = h_1 b s_0$ and the hydrostatic side pressure on $B_1 C$ would be $H = \frac{h + h_1}{2} h_2 s_0$ where s_0 denotes the unit weight of the water. Due to partial cementation

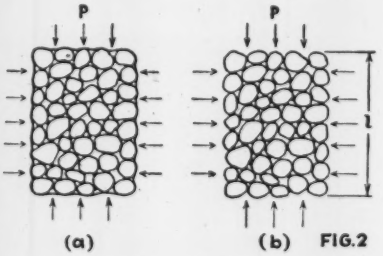


FIG. 2—SUBMERGED SPECIMENS of granular material under hydrostatic pressure with and without impermeable skin.

(Fig. 1) the pressures assume the values:

$$V_1 = h_1 b s_0 (1-m) \qquad (1)$$

$$\text{and } H_1 = \frac{h + h_1}{2} h_2 s_0 (1-m) \qquad (2)$$

Based on similar considerations, the unit weight of the submerged material reduced by the hydrostatic uplift is found to be:

$$s_2 = (1-n)[s-(1-m)s_0] = (1-n)(s-s_0+m s_0) \qquad (3)$$

where n denotes the volume of voids and s the unit weight of the dry substance. The quantity m will be called the "coefficient of grain contact." The value $1-m$ corresponds to Parsons' "effective area." For sands, according to previous test results, $m = 0$, $V_1 = V$, $H_1 = H$, and $s_2 = (1-n)(s-s_0)$.

Thus the problem consists merely of determining the value m. The method used by Parsons and other workers in this field cannot be used for very fine-grained materials because the disturbing effect of the time element rapidly increases with decreasing grain size. Therefore the writer adopted an indirect method based on a generalized interpretation of the well-known rupture diagram of Mohr.

Interpretation of rupture diagrams

In Fig. 2, sketch (a) represents a cross-section through a cylindrical specimen of a granular material, as, for instance, mortar of portland cement. The thickened lines indicate those spots where the grains are cemented together. The specimen is supposed to be dry and completely covered with an impermeable skin. It is submitted to a compression test in the following manner: First, we apply to the surface of the specimen a hydrostatic pressure p per unit of area. Then we add to the constant hydrostatic pressure a linear pressure of increasing intensity acting only in the direction of the vertical axis. Upon reaching the intensity C this supplementary pressure causes failure. The value C represents the compressive strength which is associated with the hydrostatic pressure p.

According to Mohr, the influence of

p on the compressive strength C of the specimen can be represented by means of the diagram Fig. 3(a). In this diagram the result of each test is represented by a circle passing through two points with the abscissas p and $(p + C)$ respectively. According to experience with granular materials, the diameter of the circles increases rapidly from the origin O toward the right. Rupture as a rule occurs along shearing planes which form an angle $(90—\alpha)$ with the direction of the supplementary pressure C.

If we draw a straight line from the center of any circle to the point of contact B_1 between this circle and the envelope A_1 A_2 of all the circles of rupture, the angle between this line and the axis is equal to 2α. The ordinate B B_1 of B_1 is the shearing stress, and the abscissa OB is the normal stress that acted on the plane of rupture at the instant of failure.

In general, the envelopes A_1 A_2 are somewhat curved. However, for pressures p up to about 100 atmospheres the curves A_1 A_2 may be replaced by straight lines as in Fig. 3(b). According to this diagram, the resistance acting along the plane of rupture consists of two parts, viz. the cohesion c, independent of the intensity of the normal stress, and a fractional resistance OB tanϕ, whose intensity increases in direct proportion to the normal stress. For marble, Kármán[2] obtained for ϕ at low pressures a value of about 32°; and Brandtzaeg[3] for concrete at low pressures a value of about 40°. Both values are of the same order of magnitude as the angle of internal friction for sand.

Since an increase in the hydrostatic pressure p does not change the strength of the grains of a clay or of a mortar, the seat of the frictional resistance OB tan ϕ must reside in the films of solid substance at the points of contact between the grains. Hence the influence of p on the compressive strength of the materials depends exclusively on the intensity of the pressures which act at the contacts. Based on the knowledge of this fact, the coefficient of contact m can easily be determined. We simply modify the compression test by eliminating the impervious skin of the specimen and submerge the specimen, (b) in Fig. 2, in a liquid that can be brought under a pressure p. In this case one part $m\,p$ of the liquid pressure will be transmitted from grain to grain through the points or contact, while the remainder will merely be transmitted through the liquid. As a consequence, the pressure that acts on the films of cement will merely be equal to m times the pressure that acts under the test arrangement (a) of Fig. 2. Elimination of the watertight skin, therefore, should have the same effect on the compressive strength of the sample as if we reduced the intensity of the hydrostatic pressure from p to $m\,p$, and at equal

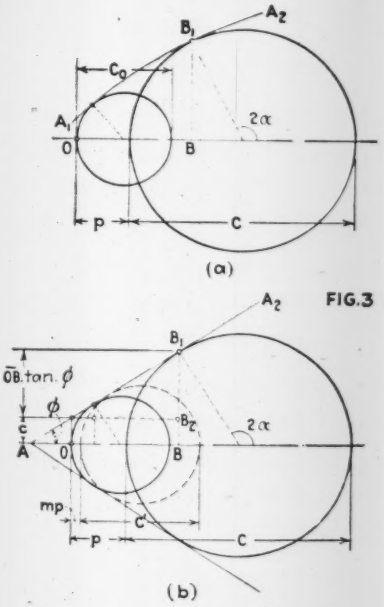


FIG. 3

FIG. 3—MOHR'S REPRESENTATION of the influence of hydrostatic pressure on compressive strength of granular material.

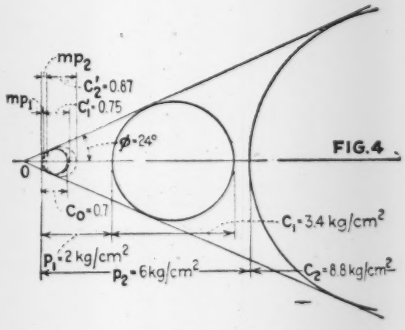


FIG. 4

FIG. 4—TEST RESULTS with plastic marine clay, showing free transmission of hydrostatic pressure.

pressures its compressive strength C' should be smaller.

According to Mohr's diagram, no rupture can occur unless the corresponding circle makes contact with the envelope A_1 A_2, Fig. 3. Hence if we represent the result of the test with the bare specimen by a dotted circle of diameter C' tangent to A_1 A_2, the abscissa of the left point of intersection of the circle with the horizontal axis is equal to the unknown quantity $m\,p$.

Results of tests and conclusions

In 1928 some tests of this kind were made with a very plastic marine clay[4], and in 1933 with concrete. The clay had a water content of 28 per cent of the dry weight, a plasticity index of 23, and an angle of internal friction of 24 deg. The concrete represented a mixture of 236 kg. of portland cement to 1 cu.m. of the finished product.

The test results for the clay, shown in Fig. 4, furnished for m a value of about 0.02. For the concrete we obtained m practically equal to zero, and a similar interpretation of the results of older tests with cement mortar[5] also leads to m almost zero. Hence, for all these materials we are obliged to assume that hydrostatic pressures are as freely transmitted through them as through coarse-grained sand. *Any surface of a solid substance in intimate contact with submerged clay or with concrete is subject to a hydrostatic pressure of the same intensity as if the adjoining porous materials were not present.*

The reason why these important facts escaped the attention of practicing engineers is to be found in the slowness with which hydrostatic uplift manifests itself in the case of fine-grained materials because of their low permeability. Suppose, for instance, that the concrete floor of a basement located below groundwater level rested on a stratum of stiff clay. In order to lift the floor, water must percolate from the sand through the clay toward the base of the floor. Since the speed of percolation of the water through a stiff clay at moderate hydraulic gradients amounts to a small fraction of an inch per year, the process would require many years in order to produce the first visible effects. Furthermore, in the majority of cases, the permeability of the concrete is considerably greater than that of the clay. Consequently the water would permanently continue to flow, the greatest part of the hydraulic head being used up within the clay on its way from the sand toward the basement. In spite of the permanent flow, the surface of the concrete in the basement can permanently appear to be dry, because even in a cellar the speed of evaporation considerably exceeds the speed of percolation through a stiff clay.

Hence empirical evidence leads to the erroneous opinion that in all such cases hydrostatic uplift is non-existent. Yet there are conditions in engineering practice under which hydrostatic uplift in clay may lead to catastrophic consequences. Consider a masonry dam resting on a stratified shale whose layers are separated from each other by thin seams of clay. According to current conceptions, the force that resists the sliding along the seams of the substrata should be equal to G tan ϕ, where G is the weight of the dam and ϕ is the coefficient of internal friction of the clay. However, due to the full hydrostatic uplift in the seams of clay, the resisting force is only

$$(G - hbs_o) \tan \phi$$

where s_o denotes the unit weight of water. The difference between the real and the assumed value of the resistance against sliding may be responsible for more than one accident of the type of the failures of Ohio River dam 26 or of the reservoir at Nashville, Tenn.

In connection with the interpretation of the results of large-scale earth-pres-

sure tests with submerged backfill the quoted facts lead to the conclusion that, if the container of the apparatus is perfectly watertight, the back of the retaining wall in contact with a submerged backfill receives full water pressure in addition to the pressure exerted by the solid fraction of the backfill. This conclusion is valid irrespective of the grain size of the backfill material.

Previous articles in this series appeared Feb. 1, p. 136, and Feb. 22, p. 259.

References

[1]H. de B. Parsons, "Hydrostatic Uplift in Pervious Soils," *Trans.* Am.Soc.C.E., Vol. 93, p. 1,317 (1929).

[2]Frank E. Richart, Anton Brandtzaeg and Rex L. Brown, "A Study of the Failure of Concrete Under Combined Compressive Stresses," Univ. of Illinois *Bulletin*, Vol. XXVI, No. 12, 1928.

[3]Th. v. Kármán, "Festigkeitsversuche unter allseitigem Druck," Ztschr. Ver. deutsch. Ingenieure, 1911, p. 1,749.

[4]K. Terzaghi, "Tragfähigkeit der Flachgründungen," *Proc.*, First Congress Int. Assoc. for Bridge and Struct. Engineering.

[5]P. Fillunger, "Versuche über die Zugfestigkeit bei allseitigem Wasserdruck," Österr. Wochenschr. für den öff. Baudienst, Wien, 1915.

Selecting Bearing Plates for Steel Beams on Masonry

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THE accompanying table has been designed to simplify the computation of design of steel bearing plates for steel beams resting on masonry. The formula usually used for the design of bearing plates is $B(B-b) = \frac{4ft^2}{3w}$ where B is the width of the plate, b is the width of the beam flange, f is the fiber stress in the plate, t is the plate thickness, and w is the bearing pressure on the masonry. This formula may be written $w = \frac{4ft^2}{3B(B-b)}$ and for any combination of B, b and t there is a certain w that will produce a given fiber stress. The accompanying table has been computed for a fiber stress of 18,000 lb. per sq.in. and shows bearing pressures corresponding to a given combination of bearing-plate width and beam size.

As an example, let it be required to select a bearing plate for a 15-in. 42.9-lb. I-beam carrying a uniform load of 2,400 lb. per foot, with a span of 17 ft., resting on a wall for which the bearing value is 125 lb. per sq.in.

The end reaction will be 20,400 lb., which will require 163 sq.in. of bearing surface. A 12x14-in. plate will provide 168 sq.in. and will produce a bearing pressure on the masonry of 121 lb. per sq.in.

From the column for $B = 12$ in., opposite $b = 5.5$ in., it is seen that a $\frac{5}{8}$-in. plate will allow a bearing pressure of 120 lb. per sq.in. without exceeding the allowable fiber stress. If a 14-in.-wide plate had been desired, t would have to be $\frac{7}{8}$ in., as a $\frac{3}{4}$-in. plate will allow only 113 lb. per sq.in. of the masonry.

The capacity of a plate thicker than those shown in the table will be $\frac{t_1^2}{t^2}$ times the tabular value for t, where t_1 is the thickness of the desired plate.

SAFE PRESSURES PER SQ.IN. ON MASONRY FOR PLATES OF STATED WIDTH AND THICKNESS FOR VARIOUS WIDTHS OF BEAM FLANGES

Formula:—$B\,(B-b) = \frac{4ft^2}{3w}$ or $w = \frac{4 \times 18000 \times t^2}{3\,B\,(B-b)} = \frac{24000\,t^2}{B(B-b)}$

Size of Beam	B	6			8			10			12			14				16				18				20			
	b | t	¼	⅜	½	⅜	½	⅝	½	⅝	¾	⅝	¾	⅞	⅝	¾	⅞	1	¾	⅞	1	1¼	⅞	1	1¼	1½	⅞	1	1¼	1½
6"I-12.5	3.33	94	203	374	90	161	252	90	140	202	93	130	177																
7"I-15.3	3.66	107	240	427	97	173	271	95	148	213	94	135	184																
8"I-18.4	4.0	125	281	500	105	188	293	100	156	225	98	141	191	67	96	131	171												
9"I-21.8	4.33	150	336	599	115	204	320	106	165	238	102	147	199	69	100	136	177												
10"I-25.4	4.66	186	419	745	126	224	352	113	176	253	106	153	209	72	103	141	184												
12"I-31.8	5.0	250	562	1000	141	250	391	120	188	270	112	161	219	74	107	146	190	77	104	136	173								
12"I-40.8	5.25				153	273	426	126	197	284	116	167	227	77	110	150	196	78	107	139	177								
15"I-42.9	5.50				169	300	469	133	208	300	120	173	236	79	113	155	202	80	109	143	181								
15"I-60.8 18"I-54.7	6.0				211	375	586	150	234	338	130	188	255	84	121	164	214	84	115	150	190	85	111	141	174	66	86	108	134
20"I-65.4	6.25				241	429	670	160	250	360	136	196	267	86	124	169	221	86	118	154	195	87	114	144	178	67	87	110	136
	6.5				281	500	781	172	268	386	142	204	279	89	129	175	228	89	121	158	200	89	116	147	181	68	89	112	139
20"I-81.3 24"I-79.9	7.0							203	313	450	156	225	306	96	138	187	245	94	128	167	211	93	121	153	189	71	92	117	144
	7.5							240	375	540	173	250	341	103	148	202	264	99	135	177	224	97	127	161	198	73	96	122	150
	8.0							300	468	675	195	281	383	112	161	219	286	105	144	188	239	102	133	169	208	76	100	127	156
	8.5										223	322	438	122	175	238	312	113	153	200	253	107	140	178	220	80	104	132	163
	9.0										260	375	510	134	193	262	343	121	164	214	271	113	148	187	232	83	109	138	170
	9.5										312	450	613	149	214	292	381	130	177	231	292	120	157	199	246	87	114	145	179
	10.0										390	563	766	167	241	328	428	141	191	250	316	128	167	210	260	92	120	152	188
	10.5													191	276	375	490	153	208	273	346	136	178	222	278	97	126	160	197
	11.0													223	321	437	571	169	230	300	380	146	190	241	298	102	133	169	208
	11.5													268	385	525	686	187	255	333	422	157	205	260	321	108	141	179	221
	12.0																	210	287	375	475	170	222	281	347	115	150	190	234

Ten Business Problems of Contracting

VIII—Surety Bonds and Insurance

Modification of present surety-bond practice is essential if contracting responsibility is to have the value which it deserves and the competitive advantage it warrants

By J. L. Harrison
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A SURETY BOND as a guarantee of the faithful performance of construction contracts is quite uniformly required of contractors handling public works and is widely required on private works of any consequence. Taken at face value, such a bond is merely a form of insurance. For a stipulated sum the bonding company guarantees the owner that the work will be satisfactorily completed and that all bills for labor and material will be paid. But, in practice, the general use of surety bonds has developed a situation that is not quite so simple as a reference to them as a form of insurance would seem to imply. This appears to be due to the quite general practice of assuming that if a contractor can secure a surety bond, he is a reliable contractor.

If experience had shown this assumption to be sound, there would be little reason for discussing surety bonds in a series of articles on the business aspects of contracting, but the facts are all to the contrary. This is not surprising. Volume is of no less importance in the insurance business than in other business. The natural desire has been to increase volume. The inevitable result has been, in the efforts to increase volume, that business has too often been taken without proper appraisal of the risks incurred. Without going more deeply into this matter here, the result has been to underestimate the fact that a contractor can secure a bond, and to deprive this fact of the significance it ought to have.

A change is necessary

But even the fact that surety companies have taken risks they should not have assumed would be of no great consequence if it affected only the financial position of these companies. However, the effect of the course followed by these companies has by no means been as limited, nor is this its most objectionable feature. Rather, from the standpoint of the owner its most objectionable aspect has been its tendency to substitute the guarantee of a third party, as to the performance of construction work, for the guarantee which ought, in practice, to lie only in the knowledge, the responsibility and the integrity of the contractor. From the standpoint of the contractor the most objectionable aspect of the tendency of surety companies to assume doubtful risks has been the creation of an unnatural parity between more or less unreliable contractors and those of unquestionable reliability, to the definite disadvantage of those who are reliable.

It is, of course, obvious that in order to support any system of surety bonds, the reliable contractors must, in the long run, pay the costs that result from the assumption of excessive risks by the bonding companies. It is true that these are passed on to the owners, but even then it is the reliability of the stronger contractors which provides the profits out of which losses are met. For this reason, if unquestionable reliability were accepted as a sufficient guarantee of performance, as it is in most business transactions, the rates charged on other risks would be so raised that reliability would soon come to have the asset value which it deserves to have but which it does not now possess.

Perhaps, of equal importance to contractors, the tendency that surety companies have shown to guarantee the offers of unreliable contractors has had the effect of measurably increasing the number of active contractors and so the intensity of competition. No doubt some will contend that "competition is the life of trade," and certainly there is a good deal to be said for that sort of competition that is effective in producing better methods and higher quality and the practices or the devices by which they can be secured. But this is not the kind of competition which results when the irresponsible are placed on equal terms with the responsible in the struggle to obtain business. Here the result is a competition usually based solely on price, with the very general result that profits are sacrificed to the good of no one and often to the very definite injury of the contractors and of the laborers they employ. For these reasons there is real ground for an inquiry as to whether the practice of requiring surety bonds as a guarantee of the faithful performance of construction work ought not to be sharply altered, if not altogether abandoned.

The most obvious objection to the abandonment of present surety-bond practices lies in the laws governing laborers' liens and materials liens. These lie against the structure and are enforceable even though the contractor has been paid in full. The surety bond has offered owners a convenient means of dealing with doubtful contractors and at the same time of avoiding the effect of these laws, for normally a surety bond guarantees the payment of all claims of this sort. But the abandonment of surety bonds would do owners no real damage here, inasmuch as there are plenty of contractors whose reliability, both financially and otherwise, is such that the position of the owner is in no wise improved by the guarantee that a surety company stands ready to give. To follow this course would then merely require owners to give due consideration to the responsibility of the contractors with whom they propose to deal—a consideration that they would expect to give in other business transactions. Obviously the penalty for carelessness in this matter would be more serious than it now is, but this cannot reasonably be considered more vital in dealing with contractors as business men than it is in dealing with men who are engaged in other activities.

Materials dealers may also be expected to object to any change in prevailing practices as to surety bonds. The basis of the credit given contractors would be entirely changed if surety bonds were abandoned. As matters stand today, if a contractor can secure a bond, he is a good risk from the material-man's standpoint, for if he does not pay, the surety company must. Here again the really reliable contractor is deprived of much of the advantage that his financial stability should give him. Moveover, in the long run the fact that financial stability is of so little value tends to prevent the improvement of this stability. Because surety bonds make the risk involved in selling to otherwise financially unreliable contractors so nearly the same as the risk involved in selling to contractors who are in a thoroughly sound financial position, there is created one of the most serious obstacles in the way of the development of a larger group of contractors whose financial position is thoroughly sound. It is hardly going too far to say that contracting as a business is quite unlikely to develop either the general strength

or the financial position it deserves to have until the surety bond is at least considerably modified, and until both owners and materials dealers are forced to deal with contractors on the same business basis that they deal with other business men.

While, to some, the writer's views as to this matter may seem radical, it is his opinion that where they are used at all surety bonds should be secured by the owner rather than by the contractor. Once the bids have been received, the owner could determine in the first instance whether a bond would be required at all. In the nature of the case, if the contractor's financial position and general reputation were satisfactory, the cost of a bond would be an entirely unnecessary expense. In the event the owner wished a bond, as the expense of securing it would fall on him and would be a clear addition to the price bid, cases would at once develop in which the low bid entered by a contractor of doubtful financial reliability would appear less attractive as compared with bids presented by contractors of unquestionable reliability and responsibility, than when they were so compared without this concrete appraisal of the amount of the risk involved.

It should, of course, be remarked that if this system were generally adopted, the cost of surety bonds written to guarantee the performance of work and the payment of bills by contractors of doubtful financial standing would be sharply increased, for this practice would rapidly eliminate the writing of bonds to cover work handled by financially reliable contractors. This, in turn, would force a fair appraisal of the risk involved in guaranteeing the performance of the work and the payment of bills by weak contractors. Responsibility would, then, have more nearly the value it deserves and the competitive advantage it warrants.

Irresponsibility encouraged

The statement made above that the use of surety bonds has tended to prevent the development of a larger body of contractors of unquestionable financial stability deserves some further comment, for the reasons that appear to justify this statement may not be altogether clear. There are a number of these reasons. Perhaps the most obvious is that the use of surety bonds has sharply increased competition, which always tends to decrease margins of profit.

If any business is to reach a wholesome position of financial stability, the average profit that well-managed concerns can secure on the money invested must be sufficient to maintain thorough financial stability. The intensity of the competition that has been developed in the construction field is at least largely responsible for the fact that contracting as a business does not now enjoy this position to the extent that would be desirable. There are, of course, a good many causes that have contributed to the creation of intense competition; in referring to the effect of the practices surrounding the use of surety bonds as one of the most important of these, there is no disposition to disregard others. Nor is the fact that surety bonds have been available to contractors of doubtful financial position the only or even the most important aspect of this matter.

A more important aspect is the fact that the freedom with which bonds have been supplied to contractors who originally were well financed has enabled those who have desired to do so to expand their business operations far beyond the limits that a reasonable appraisal of their financial position would have warranted. This has greatly weakened the financial position of such contractors, but, more to the point, it has very materially increased the volume of competition, for it has expanded the field which supposedly well-financed contractors could cover and therefore the volume of work that they were endeavoring to secure. The result has been to lower margins of profit and, as a natural corollary, to force the acceptance of relatively small net earnings on such capital as was invested in the business.

That the ease with which bonds could be secured has had the effect of expanding the field that contractors could cover deserves some further comment. When surety companies underwrite the risk involved in construction work and in so doing guarantee the payment of bills, the effect is about the same as an expansion of the credit available in the construction field. The usual result—a result which has been very conspicuous in the recent past—is that contractors expand the volume of business taken without correspondingly expanding their financial resources. In short, from the business standpoint, the tendency is to abandon sound business practices for speculative adventure. Occasionally the results are satisfactory, but more frequently the intensified competition so completely destroys profit that financial disaster becomes inevitable.

It may be observed in this connection that one of the causes of the fact that contractors have too large an investment in fixed assets and relatively too small an investment in working capital is the freedom with which surety bonds have been supplied. These bonds do not support investments in fixed assets. But equipment is a necessity, and so the amount of it owned by a contractor must be increased as the volume of business is expanded. Most of any money available for expansion has, therefore, been thrown onto the fixed-assets side of the capital account.

When this is done, any decline in the volume of business leaves contractors with large inventories of equipment that cannot be usefully employed and little cash with which to carry on such business as may be obtainable. In many instances this situation has been made even worse by reason of business reverses that have dissipated such limited liquid assets as there were, leaving as the only assets such as exist in the form of partly worn-out equipment—valuable enough as the assets of a going concern but of little or no value to the contractor or to any one else after the working capital has been depleted to a point that prevents further business activity.

In presenting the matter in this way there is no disposition to disregard the fact that the use of surety bonds has had its good points as well as its bad points. Rather the thought has been that the good points are so well known that they need no repetition here. The objectionable features are not as well known. Therefore they require more thought at this time—particularly as to the basic soundness of applying ordinary insurance practices in this field, for that is just what has been done in the past. In short, from the business standpoint, is it sound practice to ask the strong to guarantee the weak? The writer feels that it is not—that it is perfectly logical to expect that when this is done the weak will remain weak and that many of the strong will make themselves weak through reckless overexpansion. Finally, it is equally logical to expect that even the strong who refrain from overexpansion will find their position steadily weakened, because the excessive competition generated by a system of this sort deprives them of much of the profit required by the maintenance of a high degree of stability.

Looking back over the past ten years, it appears very clear to the writer that all of these things have taken place. Certainly contracting as a business has failed to develop the financial stability that it deserves to have. That, no one can seriously question. That there has been an overdevelopment of competition is equally clear. No doubt many will differ with the author in his conclusion that surety-bond practices are the primary cause, but in any event the tendencies and the apparent results noted in this article deserve the careful consideration of all of those who would like to see contracting attain the position of established financial responsibility and security that it ought to have.

But without regard to whether surety bonds ought or ought not to be required, as a very general rule they *are* required. Their cost is a considerable item of expense, and it ought always to be included in the price asked for handling construction work. This is obvious.

It is not, however, quite so trite to remark that as long as surety bonds are required it is desirable to know that when a bond is secured it really is a good bond. Within the past year not a few contractors have learned that fi-

nancial difficulties are by no means limited to those who handle construction work. But aside from the apparent financial responsibility of the surety company, it is not unreasonable to inquire with some care into such matters as the general standing of a company, the kinds of risks it is covering, its treatment of its customers, and any other matters that may indicate whether the company is likely to remain solvent and is endeavoring to maintain the solvency of its customers. A company which writes doubtful risks and encourages its customers to expand their operations without proper regard for their financial position should be avoided no matter what its present financial position may appear to be.

Insurance problems

Besides surety bonds, contractors are now quite generally required to carry workmen's compensation insurance. The state laws vary in regard to this type of insurance, as do the rates charged. Little need be said about this type of insurance, for it is so generally required by law that there is little or no opportunity to avoid it and little tendency to overlook it, in pricing work.

Accident liability and property-damage insurance have been brought to the attention of the public by their wide application in connection with the use of motor vehicles. Contractors who use motor vehicles find it desirable to cover these risks. Prevailing rates are so reasonable that it is pretty generally agreed that even if the number of vehicles operated is large, it still is wise to pay a responsible insurance company to carry them. While most of the claims presented as a result of accidents can be settled for a reasonable amount, occasionally these claims are so substantial that no insurance fund which a construction company would be likely to develop would cover them.

Public liability insurance is a broader coverage than ordinary liability and property-damage insurance as applied to motor vehicles. It is designed to protect the contractor against claims arising out of accidents to those not in his employ. It is a desirable form of insurance and should be more widely used.

Fire insurance is too well understood to require much comment. In the building field many contracts require that such insurance be carried. Where not required, as a rule it is not carried—a regrettable situation, for fires on construction work are common. The amount of insurance to carry depends, of course, on the nature of the work, but, in general, any construction involving the use of much combustible material involves a fire hazard that is of enough importance to warrant coverage.

In addition to these forms of insurance, all of which may be termed standard, various others not as widely used are available at quite reasonable charges. In this list should be included such types of insurance as windstorm, lightning, flood damage, boiler explosion, falsework, finished work and others which have their applications in the construction field. Even life insurance, though not as a rule considered of great importance except as a protection to the family of the insured, has its uses in the business field—in construction no less than in others—where it serves as a valuable protection to those whose commitments in a business venture are more specifically based on personal confidence in the ability of some certain individual or individuals than on the financial position of the enterprise.

Finally, as to all forms of insurance, the purchaser should ascertain just what he needs and see that this is what he gets. Years ago the writer was offered an insurance policy which, taken at its face value, paid a very liberal weekly sum in the event that the insured was incapacitated by reason of sickness. The annual premium was modest. In looking over the policy it was found that, while more than 100 diseases were listed, not one of those locally prevailing in sufficient amount to be recognized as at all common was included in the list. In fact, so a medical man told the writer, the policy represented less than a 5 per cent coverage of the prevailing disease risk.

On another occasion, in looking over a fire-insurance policy it was noted that the coverage was limited to "fires originating on the premises." It is only fair to add that neither of these policies were presented by an American company. Still they serve as well as any to illustrate the fact that the body of the policy may contain reservations about which little is said when the policy is sold but which are nevertheless of importance to the purchaser. Nor is this by any means always the fault of those who sell insurance. The modern reliable insurance agent is as desirous of selling what the customer needs as the customer is of buying it. Any trouble arising lies in the fact that there are so many variations in the coverage given by almost all types of insurance that unless both the salesman and the purchaser know pretty definitely what is wanted and why—in short, just what risks exist and therefore just what is to be covered—the purchaser is likely to find that his coverage differs in important details from that which he had intended to secure, that he has more coverage, and therefore higher rates than required by the conditions under which he is working, or that he has undercoverage. All these conditions are to be avoided.

In the modern business world there is little opportunity to obtain something for nothing and not much more opportunity to secure anything of value for less than it is worth. Insurance offers no exception to this rule. Therefore it is not surprising that cheap insurance is apt to mean fractional coverage and that careless agents are apt to sell too little or too much coverage. No responsible business man desires to create any of these situations. To avoid them, the obvious course is to select reliable agents and then to place at their disposal all of the facts involved. If this is done systematically, the result is reasonably certain to be a satisfactory coverage in all of the fields that ought to be covered at rates which are consistent with the coverage secured.

Evaporation from Soil and Vegetation

TANK TESTS of evaporation from bare soil and soil covered with various vegetation growths, including salt grass, Bermuda grass and tule, carried out in California by the Bureau of Agricultural Engineering during the past year, showed surprising rates of evaporation from the vegetation. With the water table ranging from 1 to 5 ft. below the surface, the grasses evaporated water at the rate of 43 in. to 22 in. of depth per year. Tule averaged during two years a consumption of 62 in. during six months, which was 55 per cent more than the indicated evaporation from a lake surface. Willows in one test consumed 52.7 in. per year, with the water table 2 ft. below the surface. Similarly high results were found in another area, where cattails, tules, smart weed, prickly lettuce, nettles and other weed plants were tested, showing consumptions of 5.4 to 10.6 ft. per year, or two to three times as much as was consumed by asparagus in the same period. These investigations and others on bare soil indicated that: (1) there is no evaporation from light-textured soil when the water table is 4 ft. below the ground surface, and very little when it is as low as 2 ft.; (2) in general, evaporation from cultivated soil is small and little importance in comparison with the amounts transpired by the crops and weeds; (3) salt grass and Bermuda grass use about the same amount of water as cultivated crops grown under similar conditions; (4) although use of water by tules or cattails in tanks in exposed locations is not necessarily indicative of the use by such plants growing in their natural environment, these plants often occupy relatively narrow strips along the borders of canals and reservoirs, and there they may use as much as 12 to 15 acre-ft. per season; (5) wire-rush growths use more water than either the wild grasses or willows where there is a high water table.

Canalizing the Mississippi for 9-Ft. Navigation

Plan for locks and dams for slackwater navigation between St. Louis and the Twin Cities, begun with $33,500,000 PWA appropriation, is one of the greatest river improvement projects of the world

SLACKWATER navigation improvement of the Mississippi River from St. Louis to Minneapolis, planned at a cost of $124,000,000, has been actively started with a $33,500,000 allotment from the Recovery Act funds. As planned, the improvement calls for 27 lock and dam structures, including the four already built. As of March 1, construction had been begun either on lock or dam, or both, of fifteen other structures. Speed in getting the emergency employment funds going out in actual wages has been actively sought by the engineers of this project.

Two of the lock operations, Nos. 4 and 5, where the interesting construction process of pumping the concrete was employed, were described in *Engineering News-Record*, Jan. 25, 1934, p. 101. In articles to be published soon the lock and dam at Rock Island, Ill. (No. 15), including twin locks and the largest roller-gate dam yet constructed in the United States, will be described. The present article will indicate briefly the engineering studies made and the conclusions that led to the decision on the dam-and-lock plan as an improvement policy.

General plan

The navigation improvement of the upper Mississippi contemplates securing a 9-ft. navigable depth by a series of pools formed, as stated before, by 27 movable-gate dams having on one shore locks to pass shipping. The general plan is essentially that made familiar by the lock and dam improvement of the Ohio and smaller rivers, but notable changes have been made in type of dams, and generally the dams are larger structures.

The location and number of dams are shown by the accompanying map. In general, location was fixed by river profile and by the practicable heights of dams as limited by flowage damage by the pools. To facilitate navigation, lock location in fairly straight reaches of channel was desirable because of better current and approach conditions. With these two general requirements satisfied, exact selection of site was determined by foundation conditions and conditions favoring construction operations. Design of dams and locks will be considered further, but at the moment it is important to mention the wide studies from which choice was made of lock and dam improvement

Formulative studies

Improvement of the upper Mississippi for navigation is not a new consideration; it has been going on for years, largely in the form of wing dams for channel regulation and of dredging of shallows and crossings. The objective of this work has been 6-ft. navigation. Also before the present project some lock and dam work had been done to meet a local requirement or as a part of a private development. In general, diking and dredging were the main resorts, and they had with difficulty maintained a 6-ft. navigable depth.

In the River and Harbor Act of 1927, Congress provided for surveys for a 9-ft. channel improvement, and the work was assigned to a special board consisting of Col. Geo. R. Spalding and Col. Wildurr Willing, Corps of Engineers, and W. H. McAlpine, head engineer. This board presented an interim report in 1929 and a full report in 1931, which embodied in all essentials the present plan. As completed, the surveys included line and distances, topography, hydrology and, in sufficient measure, geology of the river and valley within the range affecting navigation improvement.

Existing navigation improvements on the scale of a 9-ft. channel were found to be as follows: Beginning at the Washington Ave. Bridge in Minneapolis, Minn., for 37 miles down the river, the river had been canalized by the Twin City and the Hastings dams (Nos. 1 and 2 on the accompanying map). At Rock Island, Ill., 355 miles below St. Paul, there were two locks and a lateral canal, neither adequate for modern navigation; and at Keokuk, Iowa, 483 miles from St. Paul, there was the private power company dam and lock with a 41-mile pool.

The record of general river conditions showed a wide and flat valley with railways, towns and structures not far above the low-water plane. The river itself is open throughout for navigation for about seven months, the exact period depending upon the ice break-up in Lake Pepin. Sudden rises of magnitude are infrequent, and flood stages are relatively low.

Three methods of improvement were considered: (1) regulation and dredging with natural low-water flow; (2) reservoirs, regulation and dredging; and (3) canalization by locks and dams. Considering these three plans, the findings and conclusions were briefly as follows:

1. Regulation and dredging have been used for many years to obtain a project depth of 6 ft. The extreme and prolonged low-water season of 1930 provided an excellent opportunity for observing the maximum effect of regulating works. During that season it was found that about 5 ft. was the greatest depth that could be maintained above the Wisconsin River throughout a reasonably unrestricted channel. Between the Wisconsin River and the Keokuk Dam, it was impracticable to maintain an adequate 6-ft. channel throughout. Further, contraction works would unduly restrict channel widths, particularly at bends. Observations made during the low-water season of 1930 led the board to conclude that the natural low-water flow is not sufficient to provide an adequate 9-ft. channel by regulation and dredging. Below Quincy, Ill., it appears to be practicable to maintain a channel adequate for present commerce by the extensive use of modern self-propelled dredges supplementing the existing regulation works.

2. A careful study was made to determine whether a system of storage reservoirs could be constructed and operated so as to increase the natural low-water flow sufficiently to provide a 9-ft. channel with regulation and dredging during the driest years. For this purpose the minimum flow would have to be increased enough to produce an increase in the low-water stage of 3 to 4 ft. There are at present six storage reservoirs in the headwaters area, owned by the federal government and operated exclusively for the benefit of navigation. Existing power reservoirs on the Chippewa and Wisconsin rivers are operated exclusively for power purposes. There are on the Mississippi and its tributaries above Grafton, Ill., some 34 undeveloped sites having a combined storage capacity of about 11,500,000 acre-ft. If operated as a unit for the purpose of increasing the navigable depth of the upper Mississippi River, they would not increase the minimum flow above Genoa by an amount sufficient to provide a 9-ft. channel. The increase in flow below Genoa would be more than sufficient to provide a 9-ft. channel at all points except at the Rock Island Rapids and immediately below Keokuk.

Sufficient increase in minimum flow below Genoa, except at the points stated, to obtain the desired depth, could be developed by the use of only 13 of the 34 available sites, providing 7,000,000 acre-ft. of storage at a total cost of about $104,000,000. This sum is $30,000,000 in excess of the cost of the alternative canalization works. Including the cost

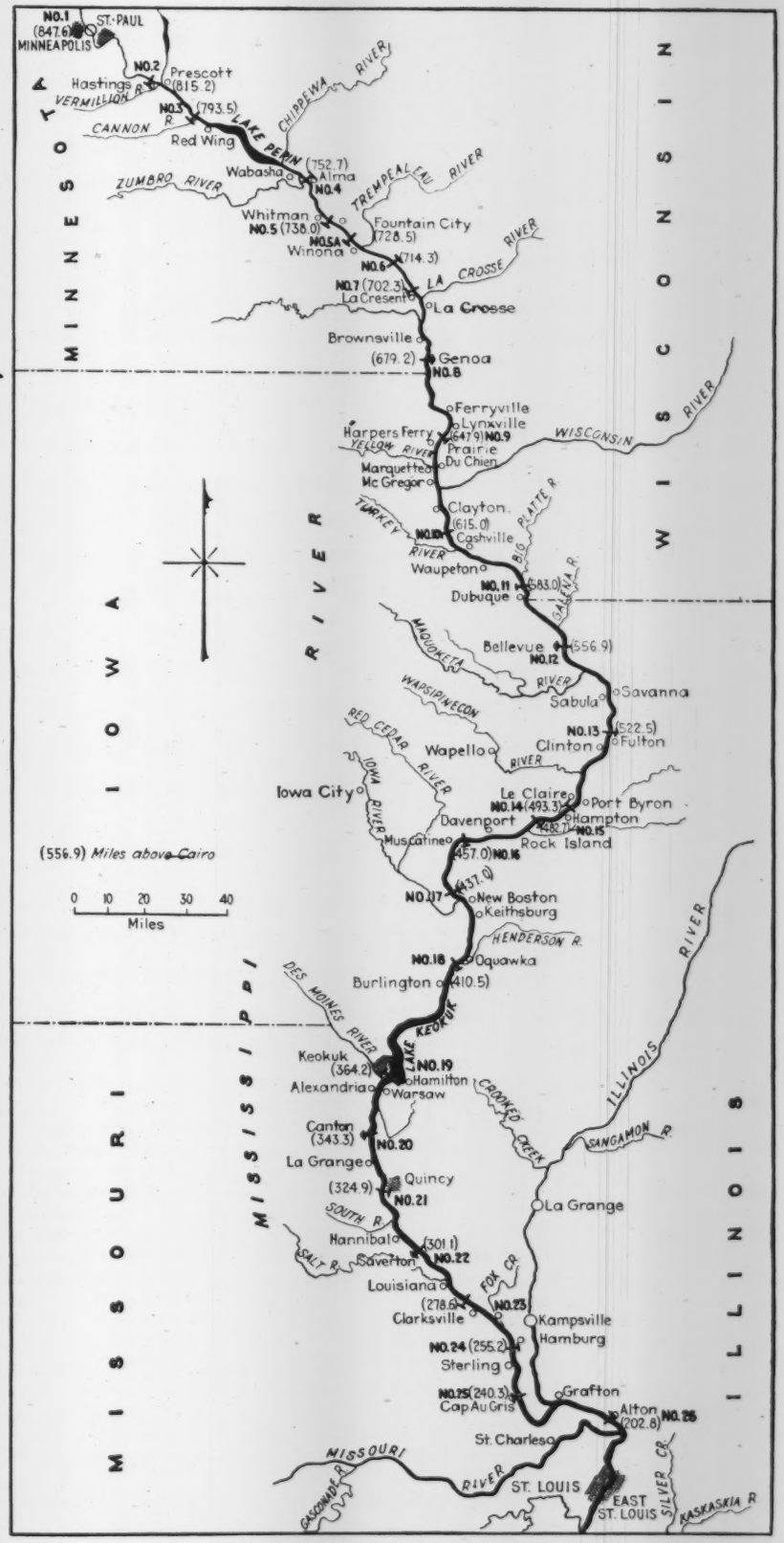
of operation and maintenance, capitalized at 5 per cent, a comparison of the capital costs of the two schemes below Genoa shows a difference of about $29,000,000 in favor of canalization. The cost of the reservoir system might eventually be shared by power to the extent of about $24,000,000, but this power development would require an additional outlay of $23,000,000, and the special board considered it unwise to allow for any such reduction in making comparative estimates in view of the lack of existing markets in the vicinity and the improbability of interesting capital in an undertaking controlled and operated for another purpose.

3. The special board concluded from financial considerations, as well as from the great difficulty of securing dependable and prompt response from a reservoir system of limited capacity, that the most feasible and economical method of securing an adequate 9-ft. channel from Minneapolis to the mouth of the Illinois is by complete canalization. While preferring canalization as the primary method of improvement, the special board believed that reservoirs may be found an important adjunct to the canalization plan. Such a system might be so operated as to benefit the Mississippi between Genoa and the mouth of the Illinois as well as below the latter point. A system of improvement which promises to increase the low-water flow of the middle and lower Mississippi would benefit all parts of the system; and the board therefore believed that the reservoirs at the headwaters should be preserved, the possibility of future development of new reservoirs exhaustively surveyed and every encouragement given to their development by private interests.

Conditions affecting design

The conditions bearing on the design of locks and dams for this project are unusual. The flood plane is from ½ mile to more than 2 miles wide at the various proposed sites, and at the majority of the sites it approaches the latter figure. Flood stages are low, increasing from about 18 ft. as a maximum at the upper end to about 21 ft. near the lower end of the proposed development. Railroads, particularly above the Wisconsin River, occupy both banks just out of reach of flood stages, and throughout the region structures and agricultural lands are found which are somewhat below flood stage. Below Muscatine, Iowa, there are numerous levees whose bases are submerged at low stages. These conditions necessitate low dams with spillways of such capacity that flood heights will not be appreciably affected.

Open river stages in excess of 4 ft. —i.e., sufficient to give about a 9-ft. depth in the present channel—prevail for but a small part of the navigation season, the duration of such stages increasing downstream. The river ice forms to a thickness of from 12 to 24 in.



UPPER MISSISSIPPI RIVER, showing location and progress of work on the locks and dams for canalizing the channel for 9-ft. navigation. Four of the 27 locks and dams have been completed, and fifteen others are now under construction.

and goes out in the spring without much gorging. Running ice conditions necessitate, therefore, that spillways of ample clear openings be provided.

Specific design adopted

In its report the board discussed the desirable specifications for ultimate channels and locks. These are:

1. Above Hastings lock and dam: tow lengths, 350 to 700 ft.; channel widths, 200 to 800 ft.

2. From Hastings, inclusive, to Lake Keokuk: tow lengths, 500 to 700 ft.; channel widths, 300 to 1,600 ft.

3. From head of Lake Keokuk to Missouri River: tow lengths, 600 to 1,000 ft.; channel widths, 500 to 2,000 ft.

Locks—For all the main locks below Hastings the locks are 110 ft. wide by 600 ft. long. At Twin City, Keokuk and Rock Island, where the dams are comparatively high and no provision for passing navigation other than through the lock is possible, there is an additional lock. The additional lock may be used in case of accident or repair to the main lock, or as an auxiliary should increased commerce require it. At the remaining dams, where the non-navigable type with lifts varying from 6 to 12 ft. has been selected, it is regarded as sufficient to provide an emergency gate that can be opened when the pool is drawn. This will permit the passage of navigation should the lock be out of commission. This gate has been designed (*ENR*, Jan. 25, 1934) so as to form an integral part of an additional lock should one be needed in the future.

Dams—The board gave very careful study to the types of dams. Fixed dams, it considered, were impracticable on account of the excessive flood damages that would accrue from backwater during freshets. Even with low movable dams and controlled pools, flood damages will run into millions of dollars. Below Twin City Dam the non-navigable type of dam has been selected. For these dams a series of tainter and rolling gates with fixed earth dam is proposed. This type of dam has been selected in preference to the Ohio River type with navigable pass, largely for the reason that it gives more dependable navigation than the latter. With the non-navigable dams the space between the piers can be readily bulkheaded and unwatered and necessary repairs made to gates. While the wickets of the navigable type can be renewed without much difficulty or interruption to navigation, renewal of the sills, which appears to be inevitable in the course of time, is very difficult, if not impracticable. Although the first cost of the non-navigable dam is somewhat greater than the navigable type, it is less expensive to operate and no maneuver boat nor large operating force are required.

Direction of work

The direction of the improvement comes under the Upper Mississippi Valley Division of the Corps of Engineers, U.S.A. The division engineer as of present assignment is E. L. Daley, Lieutenant-Colonel, Corps of Engineers, St. Louis, Mo. Information for this article has been secured from the division engineer's office and largely from the report of the special survey board named in the article.

Bank Slide in Deep Cut Caused By Drought

Dry weather a large contributing cause of slide of railway cut which resulted in a double train wreck at Cherry Hill, Va.

By Geo. E. Ladd
Engineering Geologist, Washington, D. C.

SHRINKAGE of soil strata due to a long dry spell is disclosed as the deciding factor in the caving of the bank of a railway cut, which caused the wreck on Nov. 6, 1933, of two railway trains on the Richmond, Fredericksburg and Potomac Railroad in Virginia. Water, the common cause of earth slides, therefore, escapes for once the seat in the criminal's dock. The circumstance is strange enough to warrant further record and explanation. Incidentally, the frequency with which landslides are causing trouble deserves serious consideration and indicates that engineering has far to go in establishing the certainty of one of the oldest of its construction operations.

Appalling landslide frequency

Within the last three years landslides have resulted in more than 3,000 deaths and very great material losses. Since the spring of 1931 landslides have led to at least thirteen railroad disasters, four of which were in foreign countries and nine in the United States. By these 227 people were killed and 31 were injured. Losses due to relatively small slides of fills and half-fills amount to millions of dollars annually. Small fill-slides have wrecked many trains.

Most of the losses and disasters are preventable within economic limits as to cost. Prevention and control lie, not too deeply buried, within the rocks, sediments, weathered residual matter and materials used in artificial fills, and within the composition, position and structural details of the geological formations at any given place, plus (usually) the reactions of these to water under various circumstances. An example of analysis and solution is furnished by the landslide at Cherry Hill, Va. Here a displacement of less than 400 cu. yd. of the bank of a cut wrecked two trains.

Slide and wreck

The first wreck was a south-bound freight which struck the toe of the slide and might have plowed through without serious derailment but that a kink in the track had been made by the impact of the slide. This distortion extended about 75 ft., with a maximum west track-shift toward the east track of 8 or 9 in. The second train, a north-bound passenger, almost immediately thereafter plunged into the wreckage of the freight, the locomotive of which lay on its side across the east track. Wreckage of the two trains filled, crossways, the cut in which the accident occurred (Fig. 1).

Fig. 1—Wreckage of two trains caused by slide of high bank of railway cut at Cherry Hill, Va., on Richmond, Fredericksburg & Potomac Railroad.

The location of this slide (Fig. 2) was near the south end, and on the west side of a cut 1,000 ft. long. The cut has a base width of about 65 ft., giving a clearance of about 20 ft. on each side of the double track. At the time of the slide there was an accumulation of weathered dribble at the foot of the face of the cut. This had no bearing on the accidents as the slide material landed beyond the toe of the dribble, shoving the track out of line. It is mentioned because in a cut of this kind, even small accumulations of weathered waste (dribble) at the foot of the face may shunt some types of slide onto the tracks.

The face of the cut on the west side has a maximum height of nearly 100

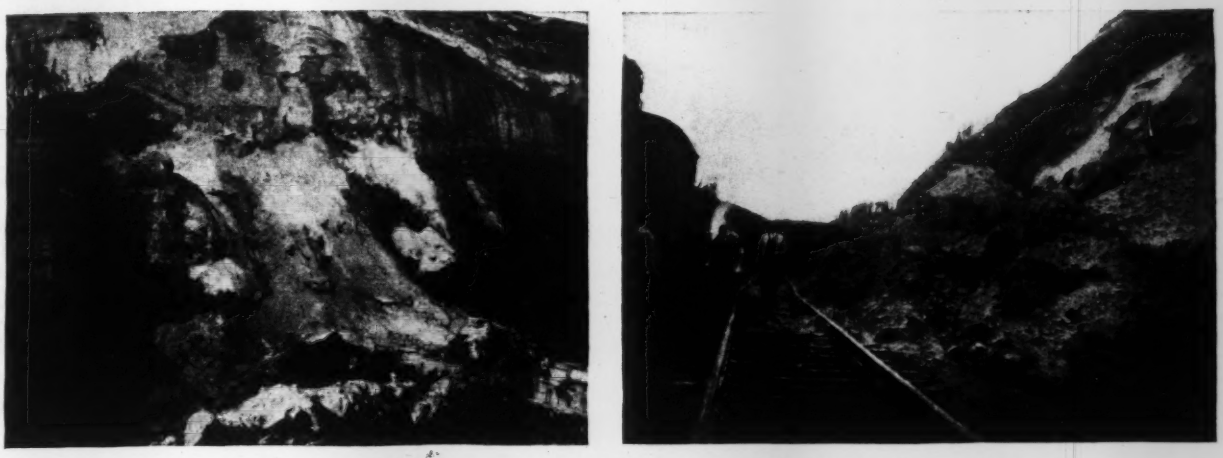


Fig. 2—Slide (left) of less than 400 cu.yd., which displaced track (right) and caused wreck of two trains as shown by Fig. 1.

ft. Its top slopes gently southward so that the face height at the point where the slide occurred is only about 80 ft. On the east side (Fig. 3) a long, relatively thin prism of the original bluff stands at a considerably lower and safer height. Both faces are exceedingly steep. Parts of them are nearly vertical. A cross-section of the cut furnished by the chief engineer of the railroad shows the slopes at a point considerably north of the place where the slide occurred. In this section the lower 43 ft. of the west face has a slope of 60 deg. From this point upward to the top, 98 ft. above, the slope gradually softens to one of 45 deg.

From a high portion of the west face, north of the spot where the recent slide occurred, a large landslide fell about five years ago—that is, shortly after the cut was excavated. Since then minor and harmless slides have fallen from the same (now recessed) part of the face. No slide has taken place on the east face, but dribble constantly falls from it.

Geological characteristics

The geological formation consists of fragmental materials derived from the ancient metamorphic (mostly) rocks of the near-by Piedmont Plateau. The formation is sedimentary and was laid down in unquiet waters with many currents and cross-currents. All materials deposited were relatively fine, but all very fine material was carried away to be dropped in still waters. Hence there are found here no colloid-type clays to become plastic and unstable when wet. The individual beds vary greatly and characteristically in thickness. At the site of the slide there are three well-defined beds of fairly uniform thickness. Overlying these is a top bed; it was not a factor in this slide.

Along the major bedding planes there are, irregular in extent, thin beds and lenses of sand and very coarse plates of kaolinite. In places they thicken. Sometimes they merge, above or below, into the type of material that characterizes the adjacent massive beds, which are composed of fine sand, coarse silt, some kaolinite and an abundance of micaceous minerals. In considerable areas they are partly indurated. One of the upper thick beds is locally called a marl, probably because of its pale greenish color which is due to the presence of quantities of thin plates of the micaceous mineral sericite. The induration, varying in degree, and extending irregularly throughout these beds, is probably due to the presence of films of calcareous or silicious binder. Shattered boulders of this material may be seen in the slide prism. It is said that during excavation of the cut the steam shovels were unable to dig into some of this material, or did so with difficulty. In drawings by engineers of the railroad company these harder beds are referred to as stone. This classification is deceptive.

A subdivision of the bottom stratum is slightly folded at one point (Fig. 3) showing uneven horizontal compression at some early period. This suggests the development of some jointing in the overlying beds. Such joints in fact, do so occur. Joint planes are fractures, usually occurring in parallel series. They should be differentiated from bedding planes, which mark successive depositions of sediment and which, in original position, are normally approximately horizontal. Cross-bedding due to a special type of sedimentation is an indication of weakness in slightly consolidated materials. Much of it characterizes all of the beds exposed in both east and west faces.

Causes of slide

Near and at the bottom of this stratum, where the break occurred, is another area of weakness, more effective because of position and character, which is remarkable in the details of its composition. It consists of a large amount of very coarse kaolinite flakes, mixed with some quartz sand and a great deal of sand made up of feldspar fragments that are completely covered with kaolinite. The latter mineral was not deposited there as sediment, but has originated in its present site through weathering processes acting on the feldspar sand. The fine, loose material back of and above the main slide mass is made up of this kaolinite-feldspar sand and some quartz sand. The combined position and character of this material was, in part, a determining factor in the causes of this particular slide. Elements of structural weakness such as are here described are widespread in and among the beds exposed in the cut.

At the time of inspection by the writer, a few days after the double accident, seepage water was emerging at three points along the top of the second bed, and within the area of the slide. At one of these points the flow was considerable, but all traces of seepage here had disappeared a few days later. In all probability this water originated from a rainfall that took place on Dec. 6, during the day of the slide but *after* it had occurred. Chief engineer Hastings assured the writer that he had inspected this face a day or two before the accidents and that there was no trace of seepage at this point at that time. Whatever the facts as to this, so far as immediate causes go, we are dealing with a dry slide.

Finally, there is the matter of joint planes to consider as causative agencies. Marking the right-hand side of the fresh break in the face of the cut, there is a vertical joint plane that penetrates the beds at an angle of 35 or 40 deg. This joint destroyed horizontal cohesion and strength along the beds. At various places the formation on both sides of the cut is traversed by joint planes parallel to this one. More serious, however, is another set of joint planes, near the exposed face on the west side (only) and parallel to that face. These joints are local.

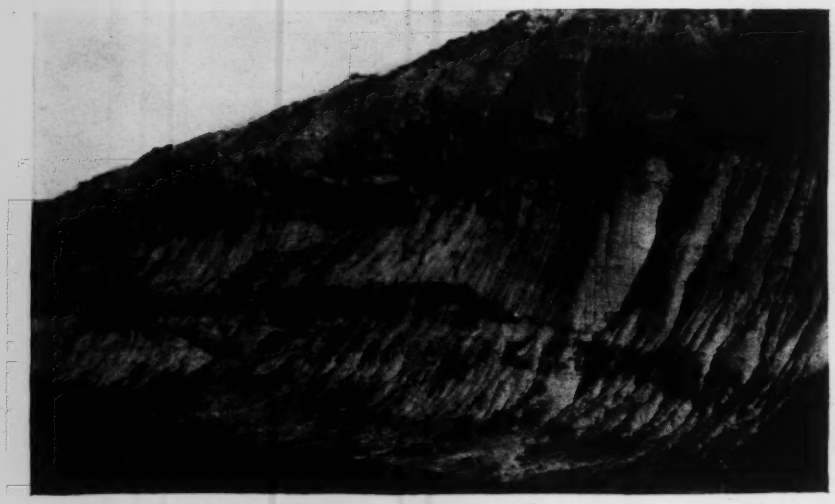


Fig. 3—Side of cut opposite slide, showing three sand-micaceous-silt strata separated by roughly horizontal bedding planes.

What actually happened was the collapse of a small portion of the face of the third stratum above the bottom of the cut, due to the weaknesses above described. Its sharp descent, through impact, took with it a portion of the face of the second stratum. This mass pitched forward and outward and constituted a roughly outlined prism, the outer edge of which lay upon the southbound track. Behind it a fanlike stream of fine material poured down.

Classification of slide

Details of conditions here have been given at length because this type of landslide is of rare occurrence and because of the possibility of future slides occurring from this or other parts of the long west face of the cut. In a paper now in course of preparation for publication the writer has classified landslides as follows:

1. Flows:
   a. Mud flows consisting of clay material, volcanic ash or its decomposition products.
2. Slope readjustments in materials as follows:
   a. Soil accumulations, sometimes originating *in situ.*
   b. Talus accumulations, originating through gravity acting through frost and weathering processes working on cliff faces of rock formations, or on steeply sloped surfaces.
   c. Beds of clay or sand, associated or separate.
   d. Heterogeneous glacial debris.
   e. Unconsolidated volcanic products.
   f. Aggregates of shattered serpentine fragments, or of any of the clay-like group of serpentine minerals.
   g. Artificial fills and half-fills made of earth materials other than boulders or gravel.
3. Undetermined strata (cases not included in "subsidences" because of horizontal element in movement).
   a. Collapse with slide characteristics, resulting from squeezing out of underlying wet clay beds, or the escape of underlying sandy beds (unconsolidated).
   b. Collapse with slide characteristics, due to breaking down of underlying, weak, poorly consolidated strata; or such areas in igneous or metamorphis rock masses.
4. Structural slides on:
   a. Bedding planes.
   b. Joint planes.
   c. Fault planes.
   d. Schistose planes.
5. Clay ejection from ancient clay-filled caves that have been opened by cuts (rare).
6. Subsidences without horizontal element in movement.
7. Rock falls.

In the above scheme the slide under consideration belongs to type 3 and has some of the characteristics of both 3*a* and 3*b*. Note the phrases: "the escape of underlying sandy beds (unconsolidated)" and "breaking down of underlying, weak, poorly consolidated strata." The joint plane factors described above are matters of detail in this particular slide, but they were essential causes. Gravity is, of course, always a prime cause of landslides.

Conclusion

It is a matter of scientific interest that water does not appear to have been a present agent in causing this slide. On the contrary, a prolonged drought probably was the deciding factor. It is the writer's opinion that the actual or incipient joint planes that parallel the west face of the cut are the result of general shrinkage of the exposed beds because of excessive loss of moisture during a long dry period.

Future slides in this cut can be prevented only by extensive reduction of the slopes, either uniformly or by terracing, especially on the west face. Terracing would be better because it would make accessible all parts of the face for detailed inspection and would make strengthening of weak spots relatively easy.

Removal of Copper Sulphate From Water by Alum Coagulation

Tests indicate that large concentrations of copper sulphate will be removed by alum coagulation, within normal pH range

By C. J. Brockman
Department of Chemistry, University of Georgia, Athens, Ga.

THERE IS considerable mention in the literature of the use of copper surphate in algæ control in the raw-water supplies of municipalities. It has been known that in certain cases of careful filtration methods there has been little copper salt getting through the filters into the city clear-water supply. However, there has not been a study made of the case in the light of the modern methods of chemical control of waterworks operations based on an analysis of raw and filtered water and the close control of pH in the water-treatment plants.

During the past decade the problem of floc formation in water purification has been put on a scientific basis by the investigations of the men connected with the United States Public Health Service, and others. These investigators have studied the conditions under which the best aluminum flocs are produced, and then extended the study to include the floc from ferrous sulphate (copperas). From an examination of these publications on the alum and iron flocs and the electrometric titration curves for aluminum sulphate with sodium hydroxide and the similar curve for copper sulphate and sodium hydroxide the writer was of the opinion that at least some of the copper salt would be flocced out in the ordinary alum treatment of raw water and consequently be retained on the filters.

The first series of experiments on this problem were made on the raw-water supply of Athens, Ga. Jar tests, according to the method of the New

York State Department of Health, were used. Filter alum from the Athens waterworks was dissolved in distilled water so that when 1 cc. of this solution was added to 1 qt. of water, the alum concentration was 0.5 grain per gallon. The copper sulphate solution was so prepared that the concentration would be 0.1 mg. of copper ion per cc., or about 0.1 p.p.m. when 1 cc. was diluted to 1 qt.

The method of procedure was to add a quantity of copper sulphate solution and then alum solution to the raw water in quart jars. When the floc had settled, it was filtered through a large funnel. The filtrate was evaporated in a pyrex vessel to 50 cc., and was analyzed for copper ion by slightly acidifying with dilute sulphuric acid, then made slightly ammoniacal in order to separate the aluminum hydroxide from the copper ion by filtration. The copper ion in this filtrate was determined after evaporating the excess of ammonia by the ferrocyanide method according to Yoe. The treatment with ammonia was necessary in order to remove any residual aluminum salts that were not flocced out. The pH of the filtered water was determined colorimetrically on a 10-cc. sample of the clear filtrate.

TABLE I — REMOVAL OF COPPER SULPHATE BY FLOCCULATION

Test No.	Raw Water pH	Raw Water Alum g.p.g.	Raw Water Copper p.p.m.	Filtered Water pH	Filtered Water Copper p.p.m.
1	7.0	8.55	0.1	6.4	0.00
2	7.0	8.55	0.2	6.4	0.00
3	7.0	8.55	0.3	6.4	0.00
4	7.0	8.55	0.4	6.4	0.00
5	7.0	8.55	0.5	6.4	0.00
6	7.0	8.55	1.0	6.4	0.00

An examination of Table I indicates that in the ordinary alum treatment of water, up to 1 p.p.m. of copper ion is completely removed in the process of filtration. The mechanism by which this removal is accomplished need not concern us at present. It may be either co-precipitation with the alum floc, or it may be an adsorption on the alum floc. At any rate, there are no copper ions in the clear filtered water.

These preliminary experiments on raw water indicated that the problem should be further studied. This was done by using solutions in which the pH could be controlled over a considerable range of pH values. It was found that phosphate buffers were the most logical to use. These buffer solutions were prepared in 50-cc. volumes at a definite pH, to which were added in order the copper sulphate solution with stirring, and then the alum solution with stirring. These solutions were allowed to stand until the floc had settled. This required from four to fifteen hours. Then the supernatant liquid was filtered by decantation so that only about 35 cc. ran through and very little of the floc came onto the filter paper. Of these 35 cc., 25 cc. were used for the determination of the copper by the ferrocyanide method, and 10 cc. were used for the colorimetric determination of the pH. The results of these experiments are given in Table II. The composition of the floc was not determined in any case.

TABLE II — REMOVAL OF COPPER SULPHATE BY FLOCCULATION AT VARYING pH

Test No.	Buffered Water pH	Buffered Water Alum p.p.m.	Buffered Water Copper p.p.m.	Filtered Water pH	Filtered Water % Copper Removed
1	7.4	1,160	14.3	7.2	100
2	7.4	0	16.7	7.3	100
3	7.2	1,160	14.3	7.0	100
4	7.2	1,000	25	6.9	100
5	7.0	1,160	14.3	6.8	100
6	7.0	150	5.5	7.0	100
7	7.0	0	16.7	6.9	95
8	7.0	1,080	20	6.7	100
9	7.0	1,000	25	6.7	100
10	7.0	153	3.8	7.0	100
11	6.8	1,160	14.3	6.6	100
12	6.6	1,160	14.3	6.4	100
13	6.6	150	5.5	6.5	100
14	6.6	1,000	25	6.4	100
15	6.6	148	7.3	6.5	100
16	6.6	153	3.8	6.6	100
17	6.4	1,160	14.3	6.0	100
18	6.4	150	5.5	6.3	100
19	6.4	550	26.7	...	95
20	6.4	1,000	25	6.0	100
21	6.4	0	16.7	6.2	90
22	6.4	156	1.9	6.4	100
23	6.4	153	3.8	6.3	100
24	6.4	285	8.8	6.2	90
25	6.4	144	9.0	6.2	80
26	6.0	1,160	14.3	5.2	95
27	6.0	150	5.5	6.0	84
28	6.0	550	26.7	...	90
29	6.0	1,000	25	...	95
30	6.0	1,080	20	...	97
31	6.0	950	29.4	...	92
32	6.0	900	33.3	...	90
33	6.0	0	16.7	...	90
34	6.0	1,160	14.3	...	100
35	5.6	150	5.5	5.5	85
36	5.6	130	16.2	...	70
37	5.6	0	28.6	...	90
38	5.6	1,160	14.3	...	50
39	5.6	1,000	25	...	50
40	5.6	0	16.7	...	90
41	5.2	0	16.7	...	50
42	5.2	1,160	14.3	...	50
43	5.0	1,000	25	...	50
44	5.0	0	16.7	...	30
45	5.0	1,160	14.3	...	50
46	5.0	1,000	25	...	50

In tests numbered 2, 7, 21, 33, 37, 40, 41 and 44 no alum solution was added after the copper solution. These tests show that the copper is flocculated out more at the higher pH values than at the lower and that even at a pH of 5.0 half the copper ions are removed in the floc. This is of course in accord with the potentiometric titration curve for copper sulphate with sodium hydroxide, which is similar to that for aluminum sulphate with sodium hydroxide.

However, the copper curve is displaced upwards in pH with respect to the aluminum curve. The copper curve bends at about pH of 5.0 and the aluminum curve at about pH of 4.2; therefore, it is to be expected that a buffer solution with a pH around 5.0 would not cause a complete flocculation of the copper salt.

Table II indicates that when the residual pH of the buffer solution is 6.3 or above, there is a complete removal of the copper ions by the aluminum floc. It also indicates that at a residual pH of about 6.0 to 6.4 there is an average of almost 90 per cent removal, and that from a pH of 5 to 6 there is better than 50 per cent removal of the copper ions.

The conclusions that must be drawn from these data are that so long as the pH of filtered water remains above 6.3 a very heavy dose of copper sulphate may be used without there being any danger of the copper salt getting through the filters in a water-filtration plant that is using the alum treatment method.

The author is indebted to city engineer J. G. Beecham, who is in charge of the water supply of the city of Athens, Ga., for his hearty cooperation and interest as this work progressed.

Wind Studies on Building Model Show Effect of Neighboring Structures

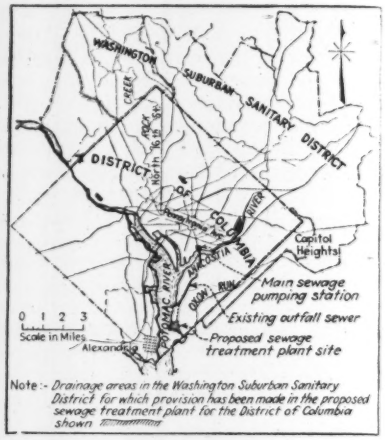
IN STUDYING wind pressure on tall buildings a question frequently arises as to the effect of neighboring structures; that is, whether the erection or the removal of adjacent buildings will endanger the safety of an existing structure. Measurements have been made in the Bureau of Standards' 10-ft. wind tunnel on a model of the Empire State Building in the presence of two models that might be erected on the adjacent blocks. The pressure was measured at three levels on the Empire State model for 24 wind directions and at three wind speeds. The results show that the neighboring structures in some instances increase the pressure on the windward face, but the suction on the lee face is simultaneously decreased, so that the resultant load is decreased. The shielding effects are quite large when the interfering structure is on the windward side and near by, the loading being reduced to as low as one-seventh of the value when freely exposed. The area shielded does not, however, extend to the full height of the interfering structure. If, in the original design, the wind loads have been reduced to allow for the shielding of existing structures, dangerous conditions might occur if the neighboring structures were removed. The shielding effects of buildings on the lee or to the side are very small. The results show that shielding may produce a variation in the twisting moment about a vertical axis at different levels. This effect may cause trouble in special cases since the stresses due to twisting moments are not ordinarily taken into account in the design of buildings. Research Paper No. 637 in the January number of the Bureau of Standards *Journal of Research* contains the complete account of this investigation.

Activated-Sludge Plant Proposed for Washington

Experts recommend use of secondary treatment during summer, with plain sedimentation only during colder months—Gas utilization and sludge washing before dewatering factors of proposed design

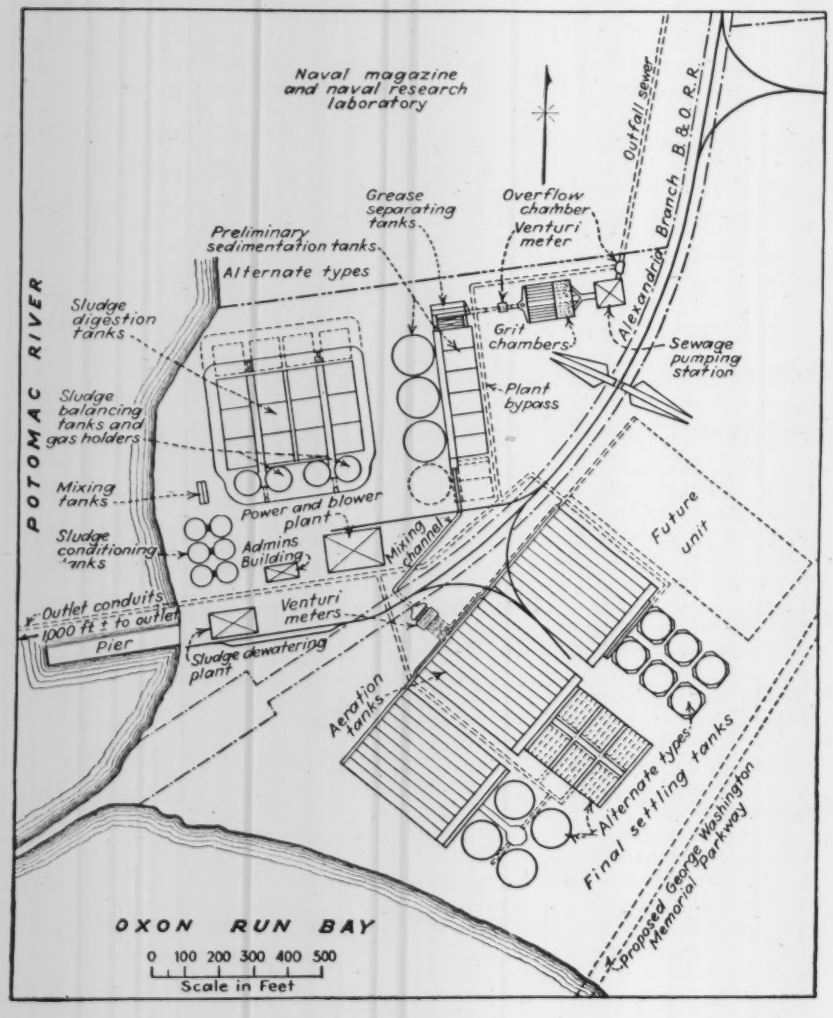
PURIFICATION of the sewage of Washington, D. C., accomplished to a high degree by the activated-sludge process during the summer months when river discharge is low, and to a lesser degree by plain sedimentation during cold weather has been recommended to the board of commissioners of the District of Columbia by a board of sanitary engineers consisting of Harrison P. Eddy, John H. Gregory and Samuel A. Greeley. The report recently submitted on sewage disposal is Part I of a three-part report, the other parts to be on the sewerage system and the formation of a joint board to protect the Potomac River from unreasonable and unnecessary pollution.

Other recommendations made were that a treatment plant of 130-m.g.d. capacity, good until 1950, be undertaken at once, that sludge be digested in gas-tight tanks and utilized in gas engines, that sludge be washed with clean water, conditioned with chemicals and dewatered upon vacuum filters, that dried sludge be used as fertilizer and humus on the 2,700 acres of ground at the District's penal institutions at Lorton, Va., that the site of the sewage-treatment plant be on ground owned by the District adjacent to the Potomac River and Oxon Run Bay, just south of the Naval Magazine and Naval Research Laboratory, and that the outfall sewer be extended a mile to the site and have a capacity of 280 m.g.d.


WASHINGTON SUBURBAN SANITARY DISTRICT
DISTRICT OF COLUMBIA
POTOMAC RIVER
ANACOSTIA RIVER
OXON RUN
Capitol Heights
Main sewage pumping station
Existing outfall sewer
Proposed sewage treatment plant site
0 1 2 3
Scale in Miles
Alexandria
Note:- Drainage areas in the Washington Suburban Sanitary District for which provision has been made in the proposed sewage treatment plant for the District of Columbia shown

DISTRICT OF COLUMBIA sewers and proposed sewage-treatment site.

PLAN OF PROPOSED sewage-treatment plant for District of Columbia.



The estimated cost is $7,900,000, and the annual operating cost is $390,000.

When completed, the treatment is expected to remove visual pollution and suspended solids likely to form deposits and to maintain a satisfactory dissolved oxygen saturation, generally in excess of 50 per cent. Bacterial pollution will be greatly reduced. The sludge utilization will provide useful employment for the inmates at Lorton. Bathing will be much safer in and below the District.

Sewage of the District is comparatively weak, and in large volume—200 gal. per capita per day. There are few industrial plants in the District. However, the experts say that the sewage is not so abnormal in any respect as to interfere with its successful treatment by biological methods.

The condition of the Potomac River in the District, as indicated by a 1932 survey, showed an average dissolved oxygen saturation at the present sewer outlets of 30 per cent, and off Fort Foote of 52 per cent, with still less on some days. On a few days it was entirely gone. The river water is visibly polluted, and gas bubbles indicate decomposing sludge deposits. The discharge is frequently below 1,575 sec.-ft.

Characteristics of the river pertinent to the disposal of sewage are the flats, tidal influences, relatively low velocity, relatively high summer temperatures and low flows. The flats in summer generate oxygen useful in oxidizing organic matter in the river by rise and fall of the tide carrying the oxygenated water to the river channel. Tidal currents tend to spread the zone of pollution and the low velocity and low volume in summer to restrict it.

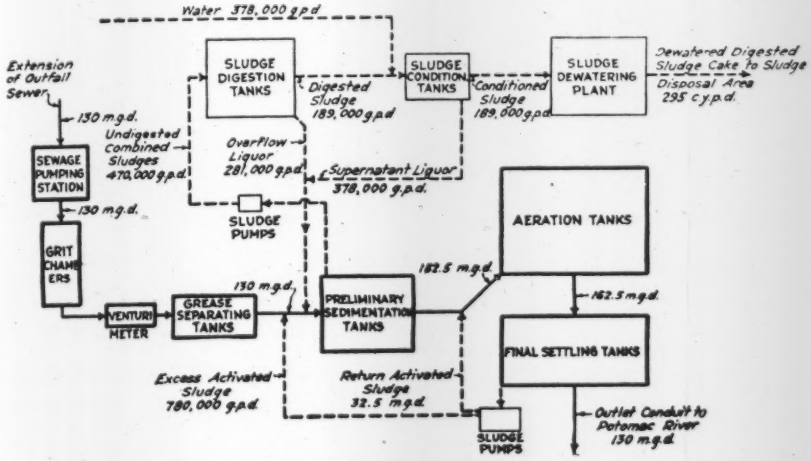
The degree of purification required was given much study. A high stand-

ard is especially desired because of the many visitors to the national capital and the historical interest of the land along the river from the District to Mount Vernon, but it was felt proper to adjust the treatment to the varying capacity of the river in order to assimilate organic matter so as to secure an economical treatment. In summer this calls for 90 per cent removal of B.O.D. and 98 per cent of bacteria. For the cooler months the purification called for removal of one-third of the B.O.D. and 50 per cent of the suspended solids.

The high degree of purification required practically precluded consideration of anything except activated sludge, but the report discusses dilution, preliminary treatments, fine screens, plain sedimentation, chemical precipitation and various means of oxidation of settled sewage, such as broad irrigation and intermittent filtration, trickling filters and activated sludge. Delayed putrification of sludge in the chemical process was a prime cause for its rejection, though much study was given to incineration. Other processes noted are chlorination of the effluent (considered unnecessary), and disposal of sludge at sea (believed too expensive on account of the 400-mile round trip). Lagooning of the sludge was not considered suitable. Digestion of sludge in septic tanks, in two-story tanks and in separate tanks was discussed. The separate-tank scheme was recommended, with the gas used for generating power and the engine cooling water used for heating the sludge. Mechanical means of dewatering conditioned sludge, incineration, disposal on land, and manufacture into commercial fertilizer were all evaluated.

Basic data for the design recommended are as follows: A tributary equivalent population of 650,000 was expected in 1950 to produce an average of 200 gal. per capita, or a total average of 130 m.g.d. A detention period in the preliminary tanks of 1.5 hours in the warmer months would be increased to 4.5 hours as plain sedimentation in the cooler months. For the aeration tanks 5.5 hours was provided for the average flow, plus 25 per cent return activated sludge. The final settling tanks would have an average operating rate of 800 gal. per sq. ft. per day. In the final settling tanks the average detention period of 2.5 hours is provided. For both summer and winter the sludge digestion and balancing tanks would have a sludge capacity of 4.6 cu. ft. per capita.

An interesting and novel feature of the design is the use of eight multiple grit chambers to keep the velocity at 1 ft. per second. The air in the grit chambers and conveyor building will be drawn through an air-cleansing equipment.



FLOW DIAGRAM for complete treatment during warmer months. During colder season aeration tanks will not be in service and final settling tanks will be used as plain sedimentation tanks, taking two-thirds of the load. The sludge-digestion tanks are to operate the entire year.

Two aerated grease-separating tanks, each 15 ft. wide by 100 ft. long, have a depth of 15 ft., giving a 4-min. detention period. Air will thoroughly agitate the sewage to dislodge grease from heavier suspended solids and perhaps coagulate some grease held in the colloidal state. The tanks will have ridge-and-furrow bottoms with porous plates in the latter. The grease, oil and other floating matter will be skimmed mechanically from the subsequent preliminary sedimentation tanks, which will have scrapers continuously pushing the sludge to cones or hoppers.

Aeration tanks will be 30 ft wide, 375 ft. long with an effective depth of 15 ft., with diffuser plates on one side of the bottom to give a vertical spiral current.

Twelve sludge-digestion tanks, 90 ft. square and 24 ft. deep, will be provided with four bottom hoppers and flat-slab concrete roofs rising slightly toward collecting domes adjacent to operating galleries. Adjacent to each battery of four digestion tanks is a sludge-balancing tank. While sludge is being pumped into the digestion tanks, sludge from these tanks will flow from the bottom into the sludge-balancing tanks. These tanks will be equipped with gas holders, which will provide a moderate volume of storage for the gas produced during the digestion process.

Sludge to Be Washed—As the sludge is drawn from the sludge-balancing tanks, it will flow through two mixing or washing channels, 10 ft. wide by 60 ft. long by 15 ft. deep, in which the sludge will be mixed with clean water and agitated with compressed air to assure a thorough admixture of the sludge and water. The construction of the mixing channels will be similar to the aerated grease-separating tanks. From these channels the diluted sludge will pass to six conditioning or washwater separating tanks, each 60 ft. in diameter with a 13-ft. depth of water in which the sludge will be allowed to stand quiescent for a period sufficiently long to permit the separation of the water and the sludge. The supernatant water will be drawn off and conducted to the incoming sewage as it flows to the preliminary sedimentation tanks.

The sludge cake from the six drum vacuum filters, 11 ft. in diameter by 16 ft. long, will be handled by mechanical conveyors from the dewatering plant to the pier and loaded on barges. The filtrate will be returned to the incoming sewage.

Two 1,200-hp. gas engines and five 1,000-hp. diesel engines will drive generators and produce electric power for the pumps, blowers and other equipment. By 1950, gas production will amount to 780,000 cu. ft. per day in summer and 460,000 cu. ft. in winter. The warm jacket cooling water from either or both types of engines will be used for the heating requirements of the plant, a large item of which is the heating of the sludge in the digestion tanks. The heat required for these tanks is estimated to average 162,000,000 and 119,000,000 B.t.u. per day during the warmer and cooler seasons of the year, respectively (as of 1950). Occasionally, especially in winter, the heat from the jacket cooling water will be sufficient for the needs of the plant. At such times additional heat will be recovered from the engine exhaust gases. The waste-heat boilers will be equipped with auxiliary gas and oil burners for use in meeting high rates of demand for heat at times of light electric power load.

Sludge on Farm Land—The District owns about 2,700 acreas of land at the Penal Institutions at Lorton, Va. Of this area more than 1,000 acres are now under cultivation, and this area is being increased at a rate of about 100 acres each year. The soil is poor for agricultural purposes, and there appears to be an excellent opportunity for the advantageous utilization of a large quantity of sludge for many years.

The quantities of sludge to be handled are estimated at 450 and 200 cu. yd. per day for five days of the week during the warmer and cooler seasons of the year, respectively, in 1938. If all of this sludge were used as top dressing and spread to a depth of ½ in., it would cover an area of 1,000 acres each year.

Should there be a surplus of sludge, there are various ravines in which it could be placed and allowed to remain. While buildings cannot be erected upon sludge deposits, there is no reason why such deposits cannot be grassed over or otherwise used for agricultural purposes.

The District maintains extensive park lands on which a large quantity of sludge can be used advantageously for top dressing and in other ways. If it should be desirable, sludge mixed with manure could be composted at the Penal Institutions, and after processing in this way it could be transported to the parks for use as a higher-grade dressing than the sludge in its original condition.

The average number of inmates at the Workhouse and Reformatory in 1933 was above 1,800, and many of these are able-bodied men for whom employment is desirable. With this supply of labor for handling and spreading sludge, the plan for disposing of the sludge at the Penal Institutions is particularly attractive.

Letters to the Editor

Computing Paving Area

Sir—In computing the paving area at street intersections, included between the arc of the curb return and the two intersecting tangents, (see *ENR*, Jan. 4, 1934, p. 17) we use the following method, rather than an approximation:

Find the area of the quadrilateral between the tangents and the radii by multiplying half the chord by the sum of the radius and the external secant, then subtract from this area the area of the sector of the circle found by dividing half the central angle in degrees by 57.3 (or the whole central angle by 114.6) and multiplying the quotient by the square of the radius. The remainder thus obtained is the area between the two tangents and the arc. With Mr. Weber's notation, the formula would read:

$$A = \frac{C}{2}(R + E) - \frac{\Delta}{114.6}R^2 \text{ in which}$$

$$\frac{C}{2} = R \sin \frac{\Delta}{2}$$

$$E = R \operatorname{exsec} \frac{\Delta}{2}$$

Cleveland, Ohio, Jan. 10, 1934.

W. M. DAWLEY, Engineer, Land & Tax Dept., Erie Railroad Co.

Vibrated Concrete

Sir—I have been much interested in the recent discussions, published in *Engineering News-Record* and other sources of information, regarding the use of vibrators in the placing of concrete. My own experience and investigations have convinced me that the best results from the said use are obtained with lean dry mixtures having slumps from 0 to 3 in. used on items such as: paving, foundation piers, footings, retaining walls and other plain shapes where dry mixtures may be used to advantage.

The use of vibrators of any type with wet mixtures, or those with slumps of more than 5 in., is apt to be detrimental, except in such instances as will be cited below. Vibration of wet mixtures tends to separate the ingredients, according to the law of gravitation, sending the heavy aggregates to the bottom and increasing the amount of laitance at and toward the top. Vibration then becomes a serious detriment, by creating an unbalanced mixture, with reduced and uneven resistance. About two years ago, the writer happened to see vibrators used in wet mixtures, to an extent that would have seemed excessive even with dry mixtures. This was on the construction of an ornamental sidehill bridge, built of reinforced concrete and consisting of a few medium-size arches and some retaining walls. A typical mixture for that class of work was used, except that it was too wet. An electric vibrator, fitted to a base board, was placed at the top of the forms and kept going while pouring went on. Every one concerned with the job seemed to be very proud of the fact that the installation was so up to date as to include vibrating machines, not evidently realizing that their use in such wet mixtures and to that extent, was bound to produce results inferior to those expected and probably, at least in some sections, weaker than the specifications demanded.

However, the moderate use of vibrators with special mixtures of sufficient fluidity to cover fully the bottom of incased steel beams and girders in horizontal positions is beneficial. Small hand vibrators, somewhat similar to the lighter type of rivet guns, operated along the outside and lower corners of the forms, will assist the concrete to flow and extend over the bottom. Since the concrete in such spaces is very thin and will gel faster than in the bulkier sections, the use of vibrators at such points should be thorough but moderate and not confined to a few occasional and concentrated spots. It sometimes happens that men handling vibrators and standing upon scaffolds beneath the floor system of a structure, when not supervised, will be reluctant to move from a comfortable spot to reach important points of inconvenient access. As the foreman and inspectors are then generally busy with the placing crew, it may happen that the work of those on the vibrators is not properly directed. The result may mean considerable patching later, which could largely have been avoided. Concentrated vibration of too long duration will create air pockets and a honeycomb surface, this being the opposite of what was expected or should result with properly applied vibration. To flow in such level and shallow spaces, the concrete should have no aggregates larger than ¼ or ⅜ in. of whole smooth gravel and not broken stone. This special mixture should be used only as required at such points, the usual mix being then resumed.

As with the sensible water-cement ratio theory, whose professed application on some jobs provides no correction for variable pre-moisture in sand aggregates and thus becomes somewhat of a farce in practice, there is danger of abusing the use of vibrators through lack of proper understanding as to where, when and how long they should be used. We still have a lot to learn on the subject, but practical sense and experience will always be needed to govern the particular requirements.

Kew Gardens, N. Y., Dec. 15, 1933.

A. M. BOUILLON.

Revenues from Sewage Effluent

Sir—I have read the article "Sewage-Plant Effluent for Boiler Water," (*ENR*, Nov. 2, 1933, p. 521), and regret that it gives inference of a profit in the operation of a sewage-disposal plant, when actually no profit exists; the annual net profit shown in the tabulation is only possible after including the sale of fresh water, amounting to about one-third of the total water consumed. In other words, while the article indicates a sewage flow of less than 350,000 gal. per day, the disposal plant takes credit for the sale of 500,000 gal., the difference being made up from the city's regular water supply. The cost of transporting the regular city water to the point of delivery is only $110 per annum as compared with a cost of $8,741 per annum for the operation of the disposal plant and the delivery of the sewage effluent. In other words, if you would cut out the cost of delivery of regular city water ($110 per annum), the total cost of operating the sewage plant and delivering water therefrom would amount to $8,741 per annum, while the revenue received from the sale of 350,000 gal. per day at 5c. per thousand gallons would amount to $6,387.50, indicating a loss of $2,353.50 per year.

Furthermore, in the average annual operating costs, the power for plant at 1c. per kw-hr., totaling $946, appears nearly to cover the cost of operating one of the 300-ft. blowers continuously, and I can only assume that no account has been taken of the cost of pumping raw sewage into the treatment plant, which is required as indicated by the text of the article.

Unquestionably the arrangement is beneficial to the railroad company and is probably beneficial to the city of Herington, by providing adequate sewage-disposal facilities at a cost of only $2,500 per year, but the fact remains, nevertheless, that the treatment plant is not operating at a profit.

Los Angeles, Calif., Nov. 22, 1933. A. K. WARREN, Chief Engineer and General Manager, County Sanitary Districts of Los Angeles County.

Sir—In reply to Mr. Warren's discussion, it is our belief that the article in question gives full explanation of the table on p. 521. It was not claimed that the sale of the sewage effluent itself would produce the net return indicated, but that this return was based on selling approximately 150,000 gal. per day of raw water from an impounded supply together with the sewage effluent. The project is actually self-liquidating on account of this fact. The raw water from the city's water supply is water that is not being used, and it seemed entirely feasible to charge only the cost incurred in delivering this water along with the sewage effluent. If there were an available market for the 150,000 gal. of water taken from the city's reservoir, the situation would call for a different analysis, but the fact remains that by using this water in this manner it is possible for the city to receive revenues slightly in excess of operating and amortization costs on the sewage plant.

The figures given in the table on p. 521 in regard to the cost of power are correct. This plant is now in operation, and in a few months it will be possible to have actual figures available for publication if desired or for other interested parties.

Kansas City, Mo., Dec. 27, 1933. N. T. VEATCH, JR., Black & Veatch, Consulting Engineers.

Wind Load on Buildings in the Netherlands

Sir—After considerable study definite rules have been established for wind loading to be used in the design of buildings in the Netherlands. Dr. Wouters, who took an active part in formulating them, kindly sent me a copy with an English translation of the same. As these rules are framed along lines of the latest scientific thought, a summary may be of interest.

The "velocity pressure," the pressure (above static or atmospheric pressure) in the middle of the windward side of a stationary plate mounted in an isolated position normal to the direction of the wind, is $(1/16)V^2$ kg/m² in which V is the wind speed in m. per sec. For V expressed in miles per hour, this is equivalent to $0.00255\ V^2$ lb. per sq.ft. It may be noted that the same value is used by Dryden and Hill in their several monographs.

The wind load is obtained by taking into account pressures and suctions which are assumed to act normal to the surfaces considered. The values of pressure and suction are found by multiplying the velocity pressure by a coefficient. Both velocity pressure and coefficient vary for the different cases considered.

In certain localities the value of velocity pressure is assumed to be 70 kg/m² (14.3 lb. per sq.ft.), and in other localities (along the sea coast) it is assumed to be 85 kg/m² (17.4 lb. per sq.ft.). These values are to be increased by 1.5 kg/m² (3.07 lb. per sq.ft.) for each 3.28 ft. above 20 m. (65.6 ft.) in height. For heights exceeding 40 m. (131.2 ft.), no further increase is required. The coefficients for the external surface of closed buildings are:

At windward side for surfaces with inclinations from 90 deg. (vertical) to 65 deg., inclusive	+0.9
At the leeward side, for all inclinations	—0.4
For surfaces parallel to the direction of the wind	—0.4
For parts of walls up to a maximum surface of 15m² (161.4 sq.ft.)	+1.2

Wind load need not be considered for the principal structure of closed buildings not exceeding 20 m. (65.6 ft.) in height, where floors and intermediate walls give adequate stiffness. With this provision the question will often arise in Holland, as it has in the United States, as to how much resistance to wind pressure can be placed upon walls and floors.

The same coefficients for the outer surface of sheds open at one side are to be used as for closed buildings. Simultaneously, when the open side is to windward, a pressure with coefficient +0.6 is assumed for the interior. If the open side is to leeward or is parallel to the direction of the wind, a suction with coefficient —0.3 is assumed for the interior.

The coefficients for permanently sheltered buildings in wind directions for which the shelter is valid can be diminished by a maximum of 50 per cent.

For open framework the combined coefficient for pressure and suction is 1.6. When two open frameworks stand one behind the other the coefficient for the second framework is 1.2. These coefficients apply to the projected surface of the bars (on the plane through the axes of the bars). A question may here arise as to how far apart the two frameworks may be before the coefficient of the second loses the value of 1.2.

In isolated walls the combined coefficient for pressure and suction is 1.4.

As the roof pressures to be used differ widely from those obtained by the familiar Duchemin formula, they are given in full. A colleague of the writer, George E. Howe, finds that they are in substantial agreement with experiments made on models (not on flat plates) by Dryden and Hill, Irminger and Stanton.

The following data summarize the rules for roofs not supported by walls.

1—The wind load on saddle roofs is to be computed in two ways (*a* and *b*) by applying the following coefficients to the upper side of the roofs:

Inclination of roof to horizontal, in deg.	Windward roof	Leeward roof	
	(a)		
0 to 20	—1.2	—0.4	
30 and over	—0.8	—0.8	
	(b)		
0	+1.2	+0.4	
10 to 20	+0.8	0.0	
30	+0.8	—0.4	β
β more than 30	+0.8	—0.4—	$\frac{\beta}{300}$

The most unfavorable case is to be taken for design purposes. For upturned saddle roofs (*U* roofs) the same coefficients are applied to the under side of the roofs.

2—Pent roofs are to be computed by applying the following coefficients to the upper side of the roofs (+ and — depending on the direction of the wind):

Inclination of roof to horizontal, in deg.	Windward half of roof	Leeward half of roof
0 to 10	±1.2	±0.4
40	±1.8	±1.0

The coefficients for intermediate inclinations may be arrived at by rectilinear interpolation.

The value of velocity pressure to be taken for chimneys is $(120 + 0.6h)$ kg/m², h being the total height in meters above the adjacent ground level. For h in ft. and pressure in lb. per sq.ft. the expression becomes $(120 + 0.197h)$ 0.205 lb/ft². The "combined coefficient for pressure and suction" on the projected surface of a chimney with circular cross-section is 0.67. It may be noted that this provision for wind loading on a circular chimney is the same as specified in the German industrial standard specification D I N 1056. Thus, the loading varies from 19.2 lb. per sq.ft. of projected surface for circular chimneys 100 ft. high to 30 lb. per sq.ft. for those 500 ft. high.

In considering the stability of a structure against overturning, the values of velocity pressure are to be increased 25 per cent and not more than two-thirds of the dead load shall be deemed to exert a favorable influence on stability. The upward force in a pillar shall not exceed the downward force in that pillar, due to two-thirds of the dead load, including the weight of a block of masonry or concrete to which the pillar is anchored.

From the foregoing it may be seen the provisions for windbracing are given in greater detail and with more refinement of classification than is usually found in building codes. At the same time they are easy of application.

New York City, Feb. 3 1934. ROBINS FLEMING.

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March 8, 1934

Effective Slum Clearance

FIFTEEN PERSONS have been burned to death in three tenement-house fires in New York within a period of two weeks. The burned structures are typical of some 65,000 others in the city that have for thirty years openely flouted the tenement-house law in the matter of fire safety and other requirements such as plumbing and ventilation. The tragedies have served thoroughly to discredit those interests who have been seeking an extension of the moratorium on repairs, granted two years ago by the legislature. They have served also to emphasize that slum improvement is more of a human than a financial problem, and most salutary of all they have given city officials the courage to exercise their seldom-used police powers in the matter of tenement-house law infractions. Already the tenement-house commissioner of New York has ordered about a dozen structures vacated on the ground that they are unsafe and insanitary. The mayor has declared that the drive will go on. This is slum clearance of an immediate and effective kind that every city in the country could emulate. If only those structures which are unfit for human habitation were taken out of circulation, there would be no debate as to whether the country is over- or underbuilt. Some of these old structures can no doubt be remodeled into satisfactory living quarters; others should never be permitted to open their doors again. It is time to quit thinking of the hardships of tenement-house owners and transfer our concern to the tenants. By merely enforcing existing laws, slum clearance could be made effective in every city in the United States in thirty days.

Water for New Jersey

STATE OFFICIALS in New Jersey are beginning to take renewed interest in supplementing the potable water supply of the densely populated metropolitan region in the northeastern part of the state. Several years ago the state became aroused over the possibility of a water shortage and set up a commission to lay plans for adding to existing supplies, but the shortsightedness that comes with hard times put a check to plans that should have been pushed at a time when property could have been obtained at reasonable figures and when construction costs were low. Progress in obtaining new water supplies is slow at best; the work needs to be put upon a continuing basis, free from the effects of business cycles and political changes if communities or metropolitan regions are not to find themselves faced with possible water shortages at periodic intervals. New Jersey is not alone in this. New York City has practically discontinued its planning for supply from the Upper Delaware River. In contrast, there is Boston on the East Coast and, the Metropolitan Water District of Southern California on the West Coast, both pushing forward the construction of new water supplies. The signs of reviving interest in New Jersey are encouraging. But in view of the long time that must elapse before actual construction of any large project can be begun, interest must be translated into action soon or northern New Jersey may yet have to cope with an actual water shortage.

A Great Navigation Improvement

CANALIZATION of some 650 miles of the Mississippi River from St. Louis north, as outlined in this issue, ranks among the great river-navigation improvements of the world. It is surpassed on American rivers only by the half-hundred locks and dams that have been completed within the last few years on the Ohio River. The interesting fact is that, while late lock design on the Ohio was followed in planning the Mississippi improvement, virtually all precedent was broken in selecting dam type and structure. A movable but non-navigable dam was adopted, and, instead of the bear traps and chanoine wickets most generally used on past canalization works, a combination structure of tainter and roller gates was substituted. The change was a logical determination from different river conditions, but it implies far more than this; it represents the definite adoption on a large scale of movable-gate types infrequently or scarcely ever previously used in river canalization in America. A discussion of this development will be presented in an article to be published in the near future, but at the moment mental note is required of the fact that the most radical change of a half-century of American river movable-dam practice is represented by the new canalization works of the upper Mississippi.

Holland Tunnel Precedents

CONSTRUCTION of a second vehicle tunnel under the Hudson River at New York will be under way within a few weeks. Fabrication of the cast-iron segments for the under-river section already is in full swing. Except that only one tube of the two-tube project will be constructed at present, the new midtown tunnel is similar to the Holland Tunnel, although some changes in details reflect experience gained since that tunnel was built. The tube diameter is larger, giving a slightly wider roadway and larger ventilation ducts. The pierhead ventilation buildings—conspicuous features of the Holland Tunnel—are eliminated in the new tunnel, primarily because of the high cost of the deep foundations required. Preliminary studies comparing the greater operating costs of the new layout with the greater initial cost of the former layout were found to favor eliminating the pierhead buildings. In general, however, the precedents set by the painstaking research, design and construction of the pioneer vehicular tunnel under the direction of Holland, Freeman and Singstad are again being used to advantage.

Concrete and the Future

THERE COMES A TIME in the development of every art when it seems that the practical zenith has been reached. Improvement has followed improvement until future development seems improbable and, if possible, at least unnecessary. Anomalous as it may seem, such a time is ideal for unprecedented advance. And the reason is not hard to find. It is that in previous years effort has been grooved toward a

certain objective, with such concentration and enthusiasm that broad vision is dimmed. The objective obtained, active minds are released and, being active, soon discover some of the unexplored paths that lead to greater heights.

Such reflections are apropos of the state of the concrete art and are prompted by the recent meeting in Toronto of the American Concrete Institute. For thirty years this body and its members have been developing a manufacturing technique for concrete, together with methods of design analysis that would utilize this concrete effectively, efficiently and safely. Good concrete can now be made, its strength can be predetermined within close limits, the more important mysteries of its chemistry have been solved, the concrete structures of every description now standing attest to design safety, and such outstanding ones as Boulder Dam are evidence of the high order of the accomplishment. What more is necessary to be done?

The papers on the A.C.I. meeting program gave some clews to the answer. Durability is still elusive; more must be done to provide concrete with resistance to weather, to salt water, to groundwater sulphates. Architectural concrete, except in rare instances, means plaster and veneer; it can be made to mean an honest expression of artistry in a structural medium. Stress analysis is still predominantly empirical, glossing over much vital knowledge by means of a factor of ignorance; the effects of plastic flow, of shrinkage, of volume change, of cracks and of impaired steel bond are known only approximately and are considered almost not at all. And to mention one of those unexplored paths that lead to greater accomplishment, there is the potential value of high-strength materials and properly placed reinforcing in increasing load capacities or making thin sections possible.

Those who have accomplished so much for concrete have actually done no more than prepare a foundation for an advance. The future of the art is full of promise and of opportunity.

What Course to Follow?

RELEASE of four million temporary workers under the Civil Works Adminstration during the next few weeks will, it seems certain, bring the most serious threat of new unemployment since last March. A few of the CWA workers will be absorbed by industry, perhaps a million by public works, but the large majority will have to go back on relief. Thus, unemployment is due to rise again sharply, and the slowly reviving business organism is in danger of a severe relapse. What shall be the nation's plan for dealing with this new emergency? Shall it be charity, "work relief" or productive work?

Let us remember clearly that recovery centers about reemployment and restoration of normal production and purchasing power. Charity methods—save for the disabled or old—and unproductive work relief can do nothing to further recovery. And so it has come to be recognized that the CWA system should not continue longer. Its unplanned and largely useless operations in the long run demoralize the workers and lay a blight on sound business activity. Each week of the CWA'S continuance makes the return from our present intensely federalized condition to one of normal social relations more difficult; it is well that the system is being closed out. But if its workers are to be returned to idleness, or perhaps to a new form of work relief, we must be willing to face the consequences.

Fortunately these men can be kept at work, and this in a service of highest productive value. The Public Works Administration, which hitherto has accomplished little, is prepared to employ them if properly utilized. *And there is no activity other than public works that is able to do so.* True, the PWA movement at present is stalled by exhaustion of its fund, but it can be set in motion again.

After its months of hopeless delay the PWA is now ready to put its first large contingent of men to work. But before it reached this point it dissipated much of the $3,300,000,000 public-works fund by diversion to ill-considered federal projects. To the surprise and alarm of the whole country only some $800,000,000 was left for local public-works. This small remainder is now exhausted, and the PWA is halted at the very time when it is ready to move with telling effect. It would be a social and economic crime to allow this paralysis to continue.

When the President called upon the local authorities of the country to mobilize all their needed improvements for the recovery campaign there was universal response. So many were submitted by states, counties and cities that nearly four billions of dollars of ready projects accumulated, for which there is no money. These four billions of projects, enough to keep three to five million men at work for a year, are spread widely over the country and would distribute their effects everywhere. They are the best and in fact the only constructive means of continuing the employment campaign.

To convert the four billions of projects into jobs and business momentum it is necessary, of course, to provide a new public-works fund. But also it is necessary to cut much of the Washington red tape so that contracts can be let quickly, for events have clearly shown the critical importance of combining CWA speed with PWA soundness of projects. The President, we feel certain, can accomplish this. By so doing he will save the recovery movement; and, incidentally, he will keep faith with the country that brought forward the projects in response to his appeal.

Obviously, only a direct, consistent course of action at Washington can bring these results to pass. Quarrels over the 30-hour week and extension of labor-union control can do no good and merely becloud the truth that the country must turn to more work rather than to less work as the means of raising itself out of the depression and that this can be accomplished most surely by continuing and vitalizing the public-works program. For, with funds to finance its full scope, with determined speeding up of procedure and protection against further federal diversion, it is well within reason to expect that a substantial proportion of the projects in the four-billion total could be under way before the end of summer, and the CWA army transferred to useful production instead of idleness. And this would go far toward assuring early and sound recovery.

CURRENT NEWS

Divisions to Handle Construction Code Statistics and Fees

AT a meeting of the Construction Code Authority in Washington, March 6, the divisional code authorities were authorized to register construction contracts and services, to supply construction statistics and to collect fees for the cost of collecting such statistics and for the administration of the codes. A procedure was also authorized for considering and examining additional chapters to the code and for advising the Administrator as to coordination of chapters as required by the master code.

Approval of the NRA Administrator of the establishment of the Construction Code Authority was received during the meeting, which was attended by three administration members. W. C. Markle, appointed by the Roofing and Sheet Metal Industries Conference and Lawrence W. Davis, appointed by the National Electrical Contractors Association, were seated during the meeting. The latter association was added on March 5 as a sponsor to the code. The next meeting of the Construction Code Authority will be held March 23, when nominations will be made for the National Construction Planning and Adjustment Board.

Contractors' Code Authority

The executive committee of the Associated General Contractors met in Washington on March 3 and succeeding days to elect twelve members of the Divisional Code Authority for General Contractors, who are to be appointed annually from the board of governors or the advisory board of the A. G. C. Chapter II—General Contractors Division of the Code of Fair Competition for the Construction Industry—provides that the Divisional Code Authority shall comprise seventeen members, twelve appointed by the executive committee and five appointed by the twelve from non-members of the A. G. C. It is understood that the twelve members have been agreed upon, and these members are now proceeding to select the remaining five.

Floods Rise on Eastern Streams Following Sudden Thaw

Rising waters reaching flood proportions are menacing life and property on streams throughout the east as a period of spring-like weather follows a month of abnormally low temperatures. In the northeastern states the situation has been aggravated by ice floes that have blocked the rivers and caused these waters to back up over long distances.

In North Haven, Conn., a dozen families were routed from their homes by the rising waters of the Quinnipiac River and many homes were threatened. Similar conditions existed along the Park and Naugatuck Rivers.

More than 200 families living near the junction of the Mohawk and Hudson Rivers are preparing to move as the Mohawk continues to rise. Around Binghamton, N. Y., floods are threatening on both the Chenango and Susquehanna Rivers.

The Monongahela at Pittsburgh on March 5 was slowly receding after having reached a stage of 22.3 ft. Damage to river shipping estimated at $150,000, was done during the high water.

In Philadelphia, the East River Drive in Fairmount Park was under eighteen inches of water for more than a mile, as the Schuylkill River rose.

Many rivers in the South were flooded as a result of the recent heavy rains. In Georgia and Alabama several streams were reported to have overflowed their banks. The Cumberland River at Nashville, Tenn., was reported above flood stage.

Activated Sludge Patents Upheld on Circuit Court Appeal

AFFIRMATION of the validity of four activated-sludge patents on which Activated Sludge, Inc., sued the city of Milwaukee has been made by the U. S. Circuit Court of Appeals for the Seventh Circuit in reviewing the decision handed down by Judge F. A. Geiger, of the district court in Milwaukee. The trial court's order for a permanent injunction closing the plant was reversed, however, the decision stating that such closure would leave the entire community without any means for the disposal of raw sewage other than running it into Lake Michigan, thereby polluting

(Continued on page 338)

New York Acts to Vacate Fire-Trap Tenements

Following tenement house fires which have claimed the lives of 15 persons in a period of two weeks, New York City officials have instituted a campaign to compel tenement house owners to bring their structures up to legal standards in the matter of fire safety and sanitary requirements. Langdon W. Post, tenement house commissioner, has already ordered some 12 buildings to be vacated. Mayor LaGuardia is giving Mr. Post every encouragement in the drive. Organized tenement house owners have threatened to abandon their structures in case repairs are insisted upon, and the Mayor and Mr. Post have arranged to transfer tenants of any such abandoned structures to vacant apartments in the neighborhoods. Conferences between the city officials and property owners have brought forth discussion of the possibility of securing federal loans for necessary repair work.

Northern Pacific Will Not Build Line to Grand Coulee Dam

Construction of a branch line railroad from Adair to the site of the Grand Coulee dam, a distance of 28 miles, will not be undertaken by the Northern Pacific Railway company, the president of the company has announced. This decision of the railroad is based upon the refusal of the government to guarantee that all freight for the dam would be moved by rail.

The railway has agreed to turn over to the government all surveys and other preliminary work done in preparation for construction. A line probably will be built by the government as part of the project.

Attorney General's Ruling Removes Obstacles To Federal Housing Operations in Cities

IN A RULING in the controversy between Secretary Ickes and Comptroller General McCarl on the status of the Public Works Emergency Housing Corp., Attorney-General Cummings stated that Title II of the Recovery Act authorizes the President to create corporate agencies to effect purposes of the title, that such corporations may be created under the laws of a state but that there are "some reasons" why it may be preferable to organize in the District of Columbia rather than in Delaware. The Attorney General held that organization expenses and capital stock required for incorporation under state law may be covered out of the public works appropriation, but that corporate powers may not exceed those necessary to carry out the public works program. Mr. Cummings suggested that the certificate of incorporation should be amended.

The housing corporation's determination as to the necessity of securing options in assembling a particular tract of land and the amount to be paid for such options is not subject to review by the Comptroller General, it is stated. The Attorney General also ruled that the corporation may purchase and convey property in its own name but that, in exercising the power of eminent domain, proceedings must be in the name of the United States. Titles to land acquired by the corporation must be examined and approved by the Attorney General before payment can be made according to the ruling.

The questions referred by Secretary Ickes to the Attorney General were raised by the Comptroller General several weeks ago and brought operations of the Housing Corporation to a standstill. Mr. Ickes declined to comment on Attorney General Cummings' opinion, which removed the principal obstacles to the corporation's operation. Several of Mr. McCarl's contentions were sustained, and it is believed probable that the housing corporations' operations will be brought into conformity with the Attorney General's opinion.

Administrations New Public Works Program Will Probably Involve Modest Sum

(Washington Correspondence)

ONLY $500,000,000 is assured for carrying on public works. Whether more will be spent depends on conditions prevailing later in the year. President Roosevelt visualizes an "elastic" program but in any case he will recommend to Congress that the funds appropriated must be kept within the budget already submitted.

The administration will present a public works bill to Congress in a week or 10 days. Able to count definitely on only half a billion, PWA Administrator Ickes said this week that $200,000,000 will be required for the second year's work on federal projects on which the first year's work was covered by allotment from the $3,300,000,000 appropriation last year. The balance of $300,000,000 from the new appropriation would, said Mr. Ickes, be applied mostly to non-federal projects. This sum represents less than 10 per cent of more than 7,000 pending non-federal project applications totaling $3,800,000,000.

The proposed division of the fund necessarily limits the scope of federal public works to the projects already undertaken; Boulder Dam, Casper-Alcova, Fort Peck, Bonneville, Grand Coulee, All-American Canal and a few other large projects. The President does not favor earmarking any funds whatever for continuing highway construction because of his disappointment that last year's appropriation of $400,000,000 has not employed as many men as expected. Contracts awarded to Feb. 24 total $261,119,000. Work is actually under way on contracts totaling $212,000,000 and directly employing 125,649.

President Roosevelt's decision not to request any money for public works outside the budget means that the money must come out of the $2,000,000,000 "recovery fund," which is tentatively ear-marked as follows: Public works, $500,000,000; Civilian Conservation Corps, $300,000,000; Reconstruction Finance Corporation, $500,000,000; relief next winter, $600,000,000; farm credit and home mortgage financing, $100,000,000. These amounts may be juggled but there is not much likelihood that the funds available will be materially larger unless Congress over-rides the President's recommendation.

Some observers in Washington believe that this is just what the President expects it to do. There is still violent disagreement among administration officials and in Congress on the efficacy of public works as an instrument of recovery but advocates and opponents agree on one thing; that a small appropriation is futile. A large appropriation has plenty of supporters, but opponents such as Lewis Douglas, director of the budget, contend that a program sufficiently large to be effective will break the Treasury and that almost any other method of combining relief and employment is much cheaper per capita.

President Roosevelt is plainly swinging toward the Douglas position, fortified by the fact that most of the huge funds appropriated for public works last year has still to be spent. Behind his "elastic" program for carrying on public works, that would amount only to $2,000,000,000 if the entire 1934-35 recovery fund were applied to public works, is the President's refusal to accept responsibility for further increasing the public debt. He reasons that if Congress elects to go in heavy for public works, the consequences are on its own head.

W. J. Patterson Made Director of I.C.C. Safety Bureau

W. J. Patterson, assistant director of the Bureau of Safety of the Interstate Commerce Commission, was appointed director on March 1, succeeding W. P. Borland, retired, and T. C. Hays was advanced to the post vacated by Mr. Patterson. The new director entered the bureau in 1914 as inspector of safety appliances and has been assistant director since August, 1918. Mr. Hays has been chief of the section of safety appliances. Mr. Borland was honored at a testimonial dinner Feb. 27 by 175 associates and friends including several members of the Interstate Commerce Commission, and officials of the American Railway Association and railroad unions.

President Recommends Guarantee of Principal of Home Loan Bonds

In a message presented to Congress on March 1, President Roosevelt recommended the passage of legislation guaranteeing the principal as well as the interest of the $2,000,000,000 of bonds issued by the Home Owners Loan Corporation. Under the terms of the Home Owners Loan Act in its present form the Treasury guarantees the interest only.

In the same message the President requested added authorization for the Home Owners Loan Corporation to lend to householders for modernization and repairs.

Federal-Aid Highway Program Now Three-fourths Under Way

The Public Works Administration has announced that more than three-fourths of the federal aid highway program is now either under construction or advertised for contract. Of the total $400,000,000 highway fund, 6,265 projects, estimated to cost $318,119,000, have been advertised for contract or placed under construction. Those projects now under construction total 3,664 and represent a total estimated cost of $212,826,000. Highway projects already completed number 681 throughout the country.

Ready-Mixed Concrete Industry Has Code Approved by NRA

National Recovery Administrator Hugh S. Johnson on Feb. 28 announced approval of the code of fair competition for the ready-mixed concrete industry. The code fixes a basic maximum work-week of 40 hours and a basic minimum wage of 35c. an hour in the South, 45c. an hour in the North, 40c. an hour in the intermediate area, and 50c. an hour in New York City, with a decreasing scale of five to ten cents an hour in cities ranging from 500,000 population down to 75,000 population, and for cities of less than 75,000 population.

MULHOLLAND DAM ABOVE LOS ANGELES, REINFORCED

Progress on the work of building an earth fill against the downstream face of Mulholland Dam, Los Angeles, is shown in the accompanying photograph. The dam is located in Weid Canyon in the hills above Hollywood. In 1931, following the failure of the St. Francis Dam, the majority of an engineering board appointed to report upon the Mulholland Dam, declared the dam to be unsafe. Subsequently the level of water in storage was lowered and now a fill is being built below the dam to provide adequate security in case of fracture of the masonry during an earthquake.

CWA Program To Be Replaced By New Relief Plan

A THREEFOLD relief program, designed to give special consideration to the varying needs of the unemployed and destitute in rural and urban areas has been announced by President Roosevelt as the sequel to the Civil Works program. The CWA program as such will be terminated March 30, a month ahead of schedule, and a new work program, in which only the needy will be employed, will take its place.

The Administration has divided the unemployed into three groups: distressed families in rural areas; those composing "stranded populations," or persons living in communities heretofore supported by a single industry which has become nonexistent; the unemployed in large cities.

Relief funds will be expended on behalf of rural families in a manner and to an extent that will enable them to achieve self-support. Work for wages from relief funds is not an essential part of this phase of the program and will be provided only in so far as it is necessary to accomplish the primary objective.

The solution of the problem of stranded populations involves the physical transplanting of families in a large majority of cases. Measures will be directed first at maintenance on small tracts of land and then at the development of supplemental or industrial opportunities to provide for a normal standard of living.

For the needy unemployed living in cities and towns, work programs which would not normally be undertaken by public bodies but which are at the same time outside of the field of private industry will be projected and prosecuted in and near industrial communities. Work will be given to an individual for a period not to exceed six months. The program will be administered by and under the direction of those responsible for the unemployment relief activities in industrial communities. Federal aid will be given to the states to finance this enterprise.

Administrator Hopkins outlined this week the procedure to be followed in cities. The program dealing specifically with the needy in rural areas will be announced following a conference in Atlanta March 12-13 with CWA administrators in southern states.

Urban procedure

Approximately 1,500,000 will be on CWA urban rolls when the program ends and about this number will be carried over by Works Divisions operating under state and local relief administrations. Workers will be transferred from federal to state, county and city payrolls. This is significant as the federal government is relieved of the responsibility for workmen's compensation in case of accidents and death.

There is no time limit on the new program and Administrator Hopkins expects better financial cooperation from the cities and counties. The mere fact that CWA was temporary was, in his opinion, a deterrent. Federal funds will be allotted to the states on the basis of need, and allotments will not be divided as between wages and materials. No quotas will be fixed as to the number that may be employed.

More attention will be given to selection of projects and Hopkins urges continuing programs planned months in advance. Executives of the Federal Emergency Relief Administration will assist state and local officials in selecting projects in accord with long range, economic planning.

Under the policy of the work program, the maximum number of hours of work per week for an individual will be 24, except for administrative, professional, and technical personnel. Time lost because of weather conditions may be made up in the ensuing 20 days.

The rates of pay will be the rate prevailing in the community for the various types of work, with a minimum, however, of 30 cents an hour.

It is expected that much of the personnel that handled CWA projects will staff the Work Divisions of the relief administrations. The Federal Emergency Relief Administration will continue its engineering staff which includes field engineers, to consult with state and local work officials on the economic and social desirability of the projects.

Silicosis Judgment Obtained Against Cement Company

A judgment for $25,000 against the Missouri Portland Cement Company was obtained recently in the St. Louis Circuit Court by Otto Horachek, who alleged contraction of silicosis while employed in the company's mill at Prospect Hill for the last 20 years. Several silicosis suits are pending in the St. Louis courts involving various companies. Testimony in a recent case revealed that 45 suits alleging contraction of silicosis, aggregating $974,000, had been filed against the Tavern Rock Sand Co. of Klondike, Mo., and that 200 more are reported as contemplated. Sixteen suits alleging silicosis have been filed against the St. Louis Smelting & Refining Co.

Ice Flow in Niagara River Stops Bridge Substructure Work

An unusually heavy flow of ice in the Niagara river has forced a suspension of work on the substructure work of the Grand Island bridges, Buffalo, N. Y., by the contractors, Booth & Flynn, Inc. Practically all of the land piers for both bridges have been completed. As the substructure work must be done in the channel of the river, it may be a month or two before work can be resumed with full force.

TVA and Florence, Ala., Agree on Power Contract

The Tennessee Valley Authority and the city of Florence, Ala., on March 4 reached agreement on terms of a contract to supply the city with electric power. The contract is similar to that drawn for Knoxville, Tenn. Florence is the third city to agree on terms with the TVA, Tupelo, Miss., being the first and Knoxville, Tenn., the second.

PWA Employment To Reach Peak In Spring Months

The peak in employment on PWA construction projects is expected to come in the late spring and early summer by Henry M. Waite, Deputy Public Works Administrator. This view was expressed by Mr. Waite after his return to Washington after an 8,000-mile coast to coast survey of the progress being made on the public works program.

"State forces reported accelerating velocity in the signing of bond purchase contracts and grant agreements, enabling the non-federal PWA projects to move forward," he said. "Contracts have been sent out covering 1,705 of the 2,186 non-federal allotments which have been made.

"The peak of the PWA re-employment should come in the late spring and early summer, according to the best analysis of the field situation.

"Pursuant to Administrator Ickes' instructions, field forces and local officials were told that allotments would be cancelled wherever construction could not start in a reasonable time because of local controversy, legal difficulty, or other causes.

"Three such cases were found. I shall recommend allotments of $300,000 for school construction in Butte, Montana; $1,500,000 for waterworks in Salem, Ore.; and $2,500,000 for a Los Angeles County office building be rescinded because the applicants are not ready to go ahead with construction under the conditions of the allotments. This money may be reallotted to some of the $3,800,000,000 in non-federal projects submitted to PWA which have received no allotments."

Mr. Waite reported that the widespread disturbance last fall over PWA wage rates and the 30-hour-week has disappeared. No protests against the wage rates were heard during the survey and they appeared to have been accepted everywhere.

Week's allotments

Allotments totaling $3,361,700 for the construction of 72 more non-federal projects were announced during the week. The money was released through reductions and cancellations of previously made allotments and changes from loan and grant allotments to allotments of grants only. Twenty-seven of the allotments announced were loans and grants, and 45 were grants only.

An allotment of $700,500 was made for air-conditioning nine federal buildings in Washington; an allotment of $1,000,000 previously ear-marked for this, was withdrawn. Designs for the work have been practically completed.

The PWA has reported that loans and grants totaling $66,202,970 have been allotted to waterworks projects in 511 cities, as of March 4.

Detroit's subway

With respect to Detroit's application for a loan and grant of $87,000,000 to build a subway, Secretary Ickes announced that the application could not be approved in its present form and will be rejected unless the city demonstrates faith in its own project. The PWA desires to assist Detroit, said Mr. Ickes, but the project must be self liquidating.

County Sewerage District Planned for Buffalo

An enabling act for creation of an Erie County sewage district commission is being drafted by Corporation Counsel George L. Grobe, Buffalo, N. Y., for submission to the present legislature. The primary purpose of the enabling act is to make it possible for Buffalo to comply with the state demand to end sewage pollution of the Niagara river and Lake Erie by construction of a sewage disposal system. The scope of the act will permit other communities in Erie county to whom the state has been making the same demand to comply. The enabling act is being drafted so that the cost of the sewage system will be charged by the commission entirely to the municipality benefitted so that other Erie county communities would not be required to bear any of the cost of the Buffalo plant. Under the plan, the PWA would finance the work, which will cost about $23,000,000.

War Department Bill Provides No New Construction Work

The War Department appropriation bill carries $24,044,945, entirely for maintenance of existing river and harbor works. The report accompanying the bill notes that a total of $178,879,208 has been allotted by the PWA and that this sum by a wide margin will not all be spent during the current fiscal year. Altogether, the additional amount required for completion of allotted projects is $282,828,850, and for all projects authorized by Congress or PWA $311,055,625.

No funds are included in the bill for flood control work on the Mississippi or Sacramento Rivers, as it is planned to carry these activities along for the present with PWA funds.

Recommendations for a number of new projects and extension of existing projects have been made to the Secretary of War by the Chief of Engineers, however.

The largest of the recommendations is construction of the New York Bay-Delaware River section of the intercoastal waterway. In the report of the Chief of Engineers, Maj. Gen. E. M. Markham, it is explained that the most desirable route for this project is by way of Raritan Bay, Raritan River, South River and across the uplands to the Delaware River at Bordentown, four miles below Trenton. The length of the waterway would be 31.5 miles, of which 15 miles would be a deep cut through land at an elevation ranging from 75 to 100 feet above sea level, rising to a maximum of 144 feet.

Plans for the project provide for a canal at an elevation of 10 ft. above mean low water, with a least depth of 25 ft., a bottom width of 250 ft. and side slopes of 2½ horizontal to 1 vertical. Dams across the Delaware River below Bordentown and across the Raritan at Sayresville just below the mouth of South River are contemplated.

Total cost of the project, exclusive of rights of way and disposal areas is estimated at about $210,000,000 with an annual cost of operation and maintenance of $1,000,000.

Extension of the Allegheny River project in Pennsylvania and New York also is recommended. It is estimated that this work, including heightening of dams and construction of new locks, would cost $2,642,000 with a maintenance cost of $96,000 annually.

Construction of the South jetty in the Wilmington, Del., harbor by the federal government instead of by local agencies was recommended. Cost of the construction is estimated at $150,000.

Dredging of a 32 ft. deep and 300 ft. wide channel in the harbor at Freeport, Tex., to replace the present 25 ft. deep and 150 ft. wide channel is suggested. It is estimated that the project would cost $115,000 annually for two years and $100,000 annually thereafter.

Expenditure of $30,000 for dredging an 18 ft. channel in the harbor of Two Rivers, Wis., is also recommended.

An adverse report was made on a project on the Colorado River in Texas.

Water Shortage at Quebec Because of Frozen Streams

A serious situation has developed with regard to the water supply to Quebec City, due to heavy ice from the continued cold winter having blocked up the flow of the streams from which the city's supply is obtained. The water level in the reservoir for the city at Loretteville is 33 in. below normal, barely covering the intake to the 40-in. main. Appeals have been made to all consumers to conserve water; and parish priests have appealed from their pulpits to their people with the same object. An emergency reservoir on the historic Plains of Abraham, holding 30 m.g., is kept in case a serious fire should develop. A thaw is expected within the next few days which may relieve the situation, but it introduces grave danger of flooding. The situation which has developed may bring to the fore the proposed Lake St. Charles storage dam, construction of which was again postponed a few months ago.

Milwaukee Filter Plant Permit Affirmed by Circuit Court

On Feb. 1 the Circuit Court of Dane County, Wisconsin, upheld the action of the state Public Service Commission in issuing a permit to the city of Milwaukee to build a water filtration plant.

Following application in July, 1933, of Milwaukee for a permit of necessity and convenience from the Public Service Commission to construct a water purification plant, opposition was recorded by the Reliance Laundry and Cleaning Company and other large consumers upon the ground that chlorinated Lake Michigan water was safe from a health standpoint and as palatable as it will be when filtered and therefore the cost would be a heavy and unnecessary burden, especially on large consumers. The Commission issued the permit, however, finding on the evidence "that public convenience and necessity require the construction and operation of a water purification

DETAILS OF PWA LOANS AND GRANTS FOR NON-FEDERAL WORK

Locality	Loan and Grant or Grant	Type	Amount
Monticello, Ark.	L. & G.	Buildings	$25,000
Jefferson, S. C.	L. & G.	Waterworks	26,000
Williamston, S. C.	L. & G.	Waterworks	135,000
Keewatin, Minn.	G.	Streets	5,400
Newcastle, Texas	L. & G.	Sewer system	38,000
Commonwelath of Mass.	G.	Hospital furnishings	10,500
Steelville, Missouri	L. & G.	Waterworks	44,000
Commonwealth of Mass.	G.	Infirmary Bldg.	73,000
Shreveport, La.	L. & G.	Municipal Bldg.	50,000
Slidell, La.	L. & G.	Water & Sewer reprs.	9,500
Cedarburg, Wis.	L. & G.	Sewage treatment	31,000
Athens Co., Ohio	L. & G.	School	26,500
Roneys Point, W. Va.	G.	Sanitarium	17,000
Trinity, Texas	L. & G.	Waterworks	24,000
Commonwealth of Mass.	G.	Power	33,000
Commonwealth of Mass.	G.	Highway	78,000
Franklin, Indiana	L. & G.	Sewage plant	50,000
Topsfield, Mass.	L. & G.	Library	15,300
Fowler, Ind.	L. & G.	Storm sewer system	39,000
Commonwealth of Mass.	G.	State Hospital	50,500
Commonwealth of Mass.	G.	State Hospital	266,500
Commonwealth of Mass.	G.	Highway bridge	261,000
Commonwealth of Mass.	G.	Industrial Bldgs.	131,500
Kalamazoo, Mich.	L. & G.	Storm sewer	45,000
Kalamazoo, Mich.	L. & G.	Storm sewer, streets	26,000
Valley City, N. D.	L. & G.	Streets	26,000
Seiling, Okla.	L. & G.	Waterworks	28,000
Commonwealth of Mass.	G.	Power plant imprvs.	62,500
Raymond, Miss.	L. & G.	Sewer system	28,000
Commonwealth of Mass.	G.	Hospital	34,000
Percy, Ill.	L. & G.	Waterworks	35,000
Commonwealth of Mass.	G.	Sprinkler system	30,500
State of Ind.	G.	Roads	34,400
State of Ind.	G.	Roads	27,600
Amesbury, Mass.	L. & G.	Roads	21,000
State of Kansas	G.	Building	29,800
Commonwealth of Mass.	G.	Hot Water system	23,000
Brooklyn, Ind.	L. & G.	Electrical system	12,000
Commonwealth of Mass.	G.	Roads	17,500
Hornersville, Mo.	L. & G.	Waterworks	30,000
Thomasville, N. C.	L. & G.	Water tank	75,000
Royal, Iowa	L. & G.	Waterworks	18,000
Du Bois, Pa.	L. & G.	School	51,000
Commonwealth of Mass.	G.	Roads	260,000
Commonwealth of Mass.	G.	Dormitory	43,700
Glen Ullin, N. D.	L. & G.	Municipal Bldg.	17,900
Commonwealth of Mass.	G.	Sprinkler system	31,000
Hardin, Ill.	L. & G.	Waterworks	42,000
Commonwealth of Mass.	G.	Channel improvements	4,800
Muscatine Co., Iowa	G.	School	3,100
Commonwealth of Mass.	G.	Dormitory	67,000
Commonwealth of Mass.	G.	Fire system	6,200
Commonwealth of Mass.	G.	Roads	37,000
Commonwealth of Mass.	G.	Assembly hall	32,500
Lamberton, Minn.	G.	Roads	6,600
Commonwealth of Mass.	G.	Boiler equip.	30,600
Commonwealth of Mass.	G.	Laundry building	27,500
Dauphin County, Pa.	G.	Auditorium	9,200
Commonwealth of Pa.	G.	School	42,600
Punxsutawney, Pa.	G.	Sewer system	5,300
Commonwealth of Mass.	G.	Bridges	60,500
Commonwealth of Mass.	G.	Hospital	97,700
Commonwealth of Mass.	G.	Road const.	61,000
Commonwealth of Mass.	G.	Water supply	21,500
Commonwealth of Mass.	G.	Storehouse	38,000
Commonwealth of Mass.	G.	Buildings	145,000
Fairfield Co., Ohio	G.	School	25,500
State of Conn.	G.	Roads	73,800
State of Conn.	G.	Roads	9,500
Commonwealth of Mass.	G.	Hospital	21,500
Commonwealth of Mass.	G.	Installation of equip.	22,000
Commonwealth of Mass.	G.	Roads	24,000
		Total	$3,361,700

plant sufficient for the city's needs until about 1950." An appeal was taken to the circuit court and new and additional evidence taken. This was submitted to the Commission by the court and the Commission reaffirmed to the court its previous recommendation.

The evidence presented to the court bore on the following questions: location and effect of sewage disposal plant on the water supply; the outlet and possible effect on the water supply of the Milwaukee, Menominee and Kinnickinnic rivers; the location, outlet and possible effect on the water supply of the storm and sanitary sewers which at times lack capacity to care for storm water, raw sewage and industrial wastes which then flow into the rivers; the possibility of contamination from the sewage of Racine, South Milwaukee and Carrollville; the bacterial conditions now and the possibility of the necessity of overchlorination in the future; the turbidity and the danger of bacterial growth in the sediment; the fact that chlorination is the only treatment now. (The dangers which arise from a failure of the operation of the system were evidenced in 1916 when the system failed to operate for 10 hours, resulting in 500 cases of typhoid and 60 deaths); the records of successful treatment by purification plants elsewhere.

The court stated that it did not "deem it necessary or profitable to here detail what the evidence shows or proves with reference to the above enumerated points. Suffice it to say that the evidence has been fully considered and that the conclusion has been reached that the findings made by the Commission are sustained by the great preponderance of the evidence."

Activated Sludge Patents Upheld

(Continued from page 334)

its waters and endangering the health and lives of more than half a million people. No such risk should be taken, said the decision.

The four patents on which the suit was brought are as follows: Claims 2, 3, 7, 11 and 13 of 1,247,540 issued Nov. 20, 1917; claims 2 and 8 of 1,282,587 issued Oct. 22, 1918; claims 5, 8 and 9 of 1,247,542 issued Nov. 20, 1917, and claims 3, 7, 8, 9 and 10 of 15,140 issued July 5, 1921. (The original patent 1,247,543 on which this last patent was based was issued Nov. 20, 1917.)

A review of Judge Geiger's decision of Feb. 7 stating the points at issue appeared in *ENR*, Feb. 23, 1933. Another article appeared in *ENR*, Sept. 21, 1933, relative to the injunction procedure.

The Sanitary District of Chicago has also been sued on the above four patents and two others. The case has been tried but the argument before Judge Walter C. Lindley has been postponed from time to time presumably awaiting the outcome in the Appellate Court, since both cases are in district courts under the Seventh Circuit.

The 30-pp. decision of the Appellate Court reviews the case in detail stating that the trial court correctly held that Jones was the original, first, and sole inventor of the patent in suit; that the claims charged to be infringed are valid claims, and that the patents in suit are entitled to effective filing dates as of the filing dates of the British patents upon which the American patents are alleged to be based.

SOCIETY CALENDAR

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill., March 13-14, 1934.

AMERICAN SOCIETY FOR TESTING MATERIALS, Atlantic City, N. J., June 25-29, 1934.

AMERICAN WATER WORKS ASSOCIATION, annual convention, New York, June 4-8, 1934.

SMOKE PREVENTION ASSOCIATION, annual convention, June 19-22, Buffalo, N. Y.

METROPOLITAN SECTIONS of American Society of Mechanical Engineers, American Society of Civil Engineers and New York Section, American Welding Society, will hold a joint meeting on March 13. There will be presented two papers dealing with special features of the Boulder Dam project, "Special Features of the Boulder Dam Project, Including Penstocks," by J. E. Trainor, and "Stresses and Strains Involved in the Boulder Dam Penstocks," by S. C. Hollister.

TRENTON ENGINEERS CLUB and NEW JERSEY ASSOCIATION OF PROFESSIONAL ENGINEERS AND LAND SURVEYS will hold a special meeting at Newark, N. J., on the afternoon of March 17 to discuss organization and registration of engineers. The meeting will be open to non-members.

CANADIAN SECTION, American Water Works Association, will hold its 14th annual meeting at Toronto, Ont., April 4-6.

INDIANA SECTION, American Water Works Association meets April 11, 12 and 13 at Purdue University, Lafayette, in a cooperative meeting with the State Board of Health, State Department of Safety and of Conservation and Fire Chiefs Organization. On April 11 a short course for water plant superintendents, filter operators and sanitarians will be given, covering such subjects as chemical treatments, tuning up new plants, inserting valves under pressure, flushing and credit information. The next day will be devoted to section papers on private wells, stream cleansing, responsibilities for potability, good will, PWA, Ohio's sewer rental law, accounting and meter research. The third day will be given over to the firemen. C. K. Calvert is secretary-treasurer.

ENGINEERING SOCIETY OF WISCONSIN at its meeting Feb. 22 and 23 elected the following officers: President, Arthur L. Boley, city engineer, Sheboygan; vice-president, H. F. Janda, professor of highway engineering and city planning, University of Wisconsin; new trustees, Robert C. Johnson and C. A. Wilson. Prof. Ray S. Owen, Madison, is secretary-treasurer.

SOUTHERN AND CENTRAL ILLINOIS WATER PURIFICATION PLANT OPERATORS' ASSOCIATION will meet March 23 at Hillsboro. Discussions will cover reservoirs, laboratory tests, cross-connections, back siphonage and Chicago amœbic dysentery lessons. Harry F. Ferguson, Springfield, is secretary.

CWA Reorganization in Illinois Brings Engineers to Front

Following the shake-up between CWA officials and the Illinois Emergency Relief Commission, which was the designated agency in charge of CWA, Leroy Hunter, regional director, temporarily took over the position of state administrator and Col. Dan I. Sultan was made administrator of Cook County. This last appointment brought the resignation of the whole administrative staff as well as top engineers and an advisory board of engineers headed by Prof. W. C. Huntington. All but the Emergency Relief people, however, are still on the job.

Frank D. Chase is state administrator and Paul E. Green is state chief engineer. Under Colonel Sultan is A. R. Lord as engineer of Cook County.

All of the downstate counties were headed up by Relief Commission committees as administrators. These administrators have been largely replaced. Project engineers have received appointments as administrators in 25 per cent of the 101 counties.

Last week Cook County had demobilized two classes of 5,000 each bringing the roll to 90,000 names. Downstate 25,000 had been laid off down to 75,000 employees. Reductions in accord with executive orders on the basis of need, single men and two in a family, have thrown a heavy burden on the administrators.

Personals

JOSEPH B. SHAW, former city engineer of Utica, N. Y., has been appointed district director of the budget for New York State. He has resigned as regional engineer for the CWA.

FELIX O. BEAZLEY has been appointed city engineer of Nashville, Tenn., after spending 22 years in the city engineering department. He has served as construction engineer for the past three years.

RALPH J. REED, consulting engineer, Los Angeles, has been reappointed for a four year term on the California State Board of Registration for Civil Engineers. The other two members of the board are HENRY D. DEWELL and ASA G. PROCTOR.

PERRY A. FELLOWS, formerly city engineer of Detroit, Mich., and more recently manager of the Detroit municipal airport, has been appointed assistant chief engineer of the Civil Works Administration at Washington, D. C.

ALFRED H. KREHBIEL has been appointed town engineer for the township of Tonawanda, N. Y.

CLAY C. BOSWELL has been named chief engineer of the Minnesota Power & Light Co. to succeed LEROY M. PHARIS. Mr. Pharis has accepted a position with the Shanghai Power Co.

T. M. BASTERASH has been named acting engineer for the Duluth, Minn., city water and light department.

LEWIS E. MOORE and EVERETT E. STONE will open a joint office in Boston, Mass., for the practice of engineering. Mr. Stone for 20 years was commissioner of the Massachusetts Department of Public Utilities, and at one time was the chief engineer of the Boston & Albany Railroad. Mr. Moore has been in consulting practice since 1921.

RICHARD O. ORTH has been appointed division engineer in charge of state highway work in the Toledo, Ohio district.

ROBERT STARR ALLYN, engineer and lawyer, has been appointed deputy commissioner in the department of sanitation of New York City to supervise the department's activities in the borough of Brooklyn.

A. RAY REILLY, engineer of the Syracuse district office of the New York state highway department, has been appointed superintendent of public works at Cortland, N. Y., to succeed John M. Olds, who retires after 16 years in that office.

WALTER D. BINGER, of the engineering firm of Thompson & Binger, New York City, has been appointed deputy commissioner of the New York City department of sanitation. He will be in charge of the city's program of garbage disposal.

H. W. HUDSON, assistant state highway engineer of New Jersey, resigned on March 1 to accept the post of construction engineer for the Triborough Bridge Authority in New York City. Mr. Hudson will be

in charge of the construction division of the Authority and will be in active charge of the construction of the Triborough Bridge.

VICTOR E. MUNCY, JR., formerly chief engineer of the Pottsville Building Block Co., Pottsville, Pa., has joined the staff of the Truscon Steel Co., of Youngstown, Ohio, as sales engineer.

Obituary

JESSE O. SHIPMAN, who retired last August as a division engineer of the New York City board of transportation, died at the age of 65 on March 1. He had been engaged in rapid transit construction in New York for more than 30 years. Mr. Shipman was graduated from Bucknell University and his early engineering activities included surveys for the Lehigh Valley Railroad and the Pittsburgh Street Railways and construction work on the Niagara power tunnel at Niagara Falls.

EDWARD M. LEFLUFY, for a number of years the waterworks engineer for the city of Vancouver, B. C., died on Feb. 18 at Trail, B. C.

JOHN JAMES HONEYMAN, 69, president of the British Columbia Architects Association, died on Feb. 18 at his home in Vancouver, B. C. He was a member of the firm of Honeyman & Curtis.

SAMUEL BRAY, civil engineer and land surveyor of Ottawa, Ont., died at his home in that city at the age of 87 on Feb. 25. For more than 20 years Mr. Bray was chief surveyor of the Indian Department.

WILLIAM ILSEMAN, builder of Rockville Centre, N. Y., died recently in that city at the age of 57.

JOHN S. ARCHIBALD, one of Montreal's leading architects, died suddenly on March 2. Born in Scotland, Mr. Archibald had practiced throughout most of his life in Montreal, having been responsible for many noted Canadian buildings, among which are many of the C.N.R. hotels including the Chateau Laurier at Ottawa. In addition to his architectural work, Mr. Archibald was vice-chairman of the Montreal Tramways Commission.

J. WILLIAM GRIFFIN, engineering superintendent of the North Jersey District Water Supply Commission, died of pneumonia on March 5, at a hospital in Glen Ridge, N. J. He was 72 years old. Mr. Griffin helped to build the Wanaque water system supplying a number of cities in the metropolitan district of northern New Jersey and was in charge of the watershed during the construction of the dam and reservoir. Besides his connection with the North Jersey commission he had acted as water engineer for the town of Kearny and had been consultant for the East Jersey Water Co., the Consolidated Water Co. and the city of Bayonne.

CONSTRUCTION STATISTICS OF THE WEEK

HIGH PRIVATE awards raise this week's contracts to $34,023,000, the high for the year. This is 300 per cent over the average March week in 1933, and brings 1934 engineering construction 30 per cent higher than the corresponding 10 weeks in 1933. Private awards of $18,625,000 are 55 per cent of the total compared with a previous average of 16 per cent on the year's awards prior to this week. Public awards dropped back 20 per cent, from $19,637,000 last week to $15,398,000 this week. Three-fourths of this drop is in federal awards and one-fourth in state and municipal. Federal awards of $3,265,000 compare with $6,370,000 last week.

Industrial buildings include the Ford hot sheet, blooming and cold rolling mills, $10,000,000, but are slightly above the average week to date without this. Total industrial building awards for the week are $12.3 millions compared with $2.8 millions, $0.5, $1.0 and $1.0 millions in the four preceding weeks. Streets and roads gained slightly over last week, $7.9 millions against $7.4 millions. Earthwork, irrigation, drainage and waterways show a large gain, $7.5 millions compared with $0.7 millions last week, and $0.9 millions the week before. A $4.9-million private project swells this total. Bridges dropped from the $2.7 millions total reported last week to only $1.1 millions.

Large projects let this week, other than the Ford mills, include elevators and mail handling equipment for the Post Office Annex, New York, $650,000, a brewery in Maryland, $500,000 and a grain elevator in Texas, $500,000. Large highway lettings include: $702,000 by Georgia, $639,000 by Ohio, $728,000 by Connecticut and $675,000 by Arkansas. A sea wall and paving to be done by force account in Seattle will cost $1,396,000; a contract by U. S. Corps of Engineers for 2 self-propelled pipe dredges, and a day labor project by Willacy County Water Control and Improvement District, Raymondsville, Tex., $4,853,000 conclude the larger projects to get under way this week.

New productive capital this week is the lowest that it has been this year. Although the municipal bond market remains strong the bond sales during the past week were for refunding, welfare, relief and soldier bonus purposes rather than new construction. State and municipal bond sales for construction totaled only $784,000, new capital stock issues totaled $107,000 for construction purposes and PWA allotments $3,362,000. New capital total for the year to date is 370 per cent ahead of the corresponding period last year.

CONTRACTS
(Thousands of Dollars)

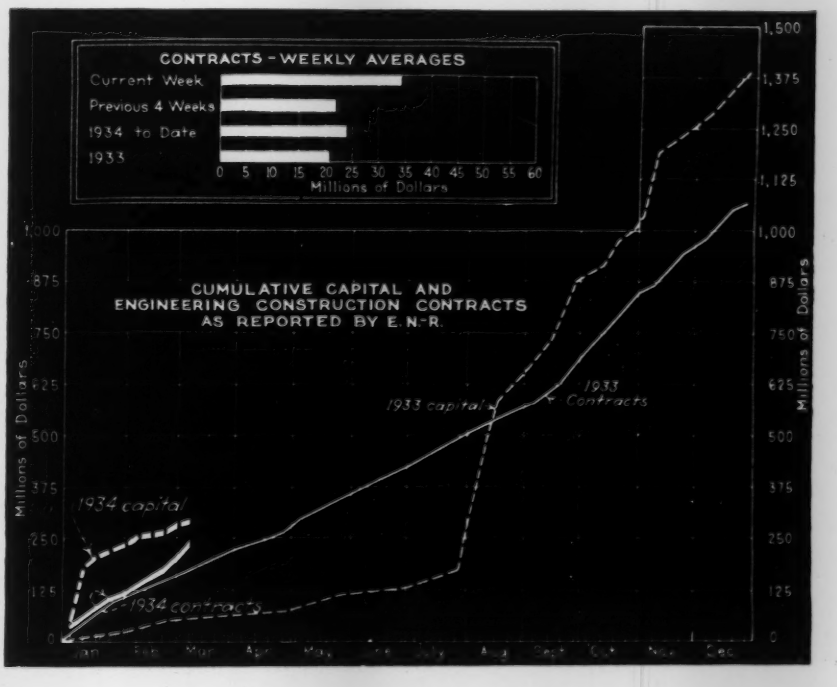
	Weekly Average Mar. 1933	Prev. 4 Weeks	Week Mar. 8 1934
Federal Government	$2,538	$4,896	$3,265
State and municipal	4,373	13,340	12,133
Total public	$6,912	$18,236	$15,398
Total private	4,675	3,473	18,625
Week's total.....	$11,587	$21,709	$34,023
Cumulative to date: 1933.....	$184,575	1934.....	$239,096

NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

1934	Week Mar. 8	Cumulative
State and municipal.....	$784	$49,287
PWA allotments, S&M..	3,362	188,819
Corporate issues	107	10,525
PWA allotments, private	....	42,119
Total, Non-Federal....	$4,253	$290,750
PWA allotments Federal Constr.	....	47,251
Total new capital.....	$4,253	$338,001
Cumulative to date: 1933.....$62,100	1934.....	$290,750
Rescinded or reduced allotments (from 1933 PWA totals).....		$43,323

INDEX NUMBER

E.N.-R.-Cost		E.N.-R.-Volume	
March, 1934....	194.04	February, 1934.	88
February, 1934....	194.04	January, 1934...	113
March, 1933.....	158.44	February, 1933..	82
1933 (Average)....	170.18	1933 (Average) ..	102
1932 (Average)...	156.97	1932 (Average) ..	127
1931 (Average)...	181.35	1931 (Average) ..	220
1913 (Average).....	100		



Construction Equipment and Materials

New Electric Erasing Machine Is Held Like a Pencil

A new electric erasing machine, light, compact and durable, is announced by the Charles Bruning Co., Inc., New York and Chicago. The new machine is designed to be held in the fingers like a pencil,

New Bruning Erasing Machine

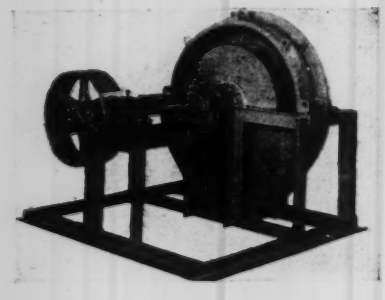
rather than in the fist, and thus to enable the operator to maintain accurate finger control when erasing pen or pencil lines from tracings or drawings. The machine is operated by a self-contained electric motor operating on 110 volts.

Soft-Stone Eliminator For Gravel Plants

A new piece of gravel plant equipment, designed to eliminate soft stone from bank run material is announced by the Knickerbocker Co., Jackson, Mich. The new machine, known as the Knickerbocker soft-stone eliminator, consists of a rotor revolving in a vertical plane within a casing and bearing impact bars of high-alloy, heat-treated steel. In operation, the eliminator is introduced into the line of production after the sand has been removed from the bank-run material. The stone is fed into the machine through an opening on the charging side, goes through the unit and is discharged at the bottom. While inside the machine, the stones are struck repeated blows by the impact bars, and are subjected to constant abrasion upon each other before being discharged. An inlet provides for the introduction of water and the pulverized soft stone runs off at the bottom in the form of a thick sludge.

The equipment is operated by a 20 hp. motor. It has a capacity of from 50 to 90 tons per hour.

The Knickerbocker soft stone eliminator for gravel plants



New Publications

STANDARD CONSTRUCTION CASTINGS, Flockhart Foundry Co., Newark, N. J. 8x11, drawings and detail dimensions of manhole frames and covers, curb inlets, drainage castings and miscellaneous castings used in construction work.

INDUSTRIAL FRICTION MATERIALS, Johns-Manville, New York, N. Y. 6 pages, 8½x11. Discusses brake blocks and brake lining and clutch facings in connection with construction and industrial equipment.

WERKSPOOR COMPRESSORLESS DIESEL ENGINES, Werkspoor, Amsterdam, Holland. 16 pages, 9x12. Illustrations.

KEEP THE TRUCKS MOVING, George Haiss Mfg. Co., New York, N. Y. 8 pages, 8x11. Describes Model 135 loader.

ROBERTSON KEYSTONE BEAM STEEL FLOOR, H. H. Robertson Co., Pittsburgh, Pa. 12 pages, 8½x11. Lightweight floor system for apartment and low-cost housing projects.

HARD-FACING WITH HAYNES STELLITE PRODUCTS. Haynes Stellite Co., Kokomo, Ind. 96 pages, 8½x11. Describing a group of abrasion-resistant materials and the hard-facing process whereby they are applied to wearing surfaces.

ENDURO, Republic Steel Corp., Youngstown, Ohio, 16 pages, 8½x11. Describing types, finishes, applications, fabrication and installation methods of stainless steel. Bulletin 124.

SULLIVAN DRILL STEEL FURNACES, Sullivan Machinery Co., Chicago, Ill. 8 pages, 8½x11. Describing oil-fired furnaces for use in resharpening drill steel.

DIAMOND LIQUID CHLORINE, Diamond Alkali Co., Pittsburgh, Pa. 32 pages, 6x9. Discusses the history, properties, handling methods and applications of liquid chlorine.

ARMORED CONCRETE, Armored Concrete Corp., Newark, N. J. Catalog IV. 22 pages, 8½x11. Data sheets on the use of a cast iron curb, step, loading platform, etc.

PERFORMANCE AND TEST STANDARDS FOR SELF-PRIMING CENTRIFUGAL PUMPS, The LaBour Co., Inc., Elkhart, Ind. 30 pages, 5x8. A set of standards for measuring all centrifugal pumps of the self-priming type.

THE AIRVEYOR, Fuller Co., Catasauqua, Penna. 26 pages, 8½x11. Describes a pneumatic conveyor for fine, crushed and granular materials.

VIBRATING SCREENS, the Jeffrey Manufacturing Co., Columbus, Ohio, Bulletin 579. 12 pages, 7½x11.

VIBRATING COOLERS-DRYERS, the Jeffrey Manufacturing Co., Columbus, Ohio. Bulletin 583, 4 pages, 7½x11.

VIBRATING FEEDERS, the Jeffrey Manufacturing Co., Columbus, Ohio. Bulletin 582, 8 pages, 7½x11.

VIBRATING CONVEYORS, the Jeffrey Manufacturing Co., Columbus, Ohio. Bulletin 581, 4 pages, 7½x11.

TIMKEN ENGINEERING JOURNAL, the Timken Roller Bearing Co., Canton, Ohio, 258 pages, loose leaf, 8½x11. Gives technical and engineering information on rating, load calculation, bearing selection, mounting, use and care of Timken bearings. For the use of engineers and machine designers.

MONOLITHIC CONCRETE SEWERS. 8½x11. 24 pages. Portland Cement Association, 33 West Grand Ave., Chicago, Ill. Design details of types and construction used in eleven leading cities.

THE TECHNICAL STORY OF TONCAN IRON PIPE. 8½x11. 24 pages. Republic Steel Corp., Youngstown, Ohio. Technical data on the manufacture, applications and performance of Toncan iron pipe.

CATERPILLAR DIESEL SEVENTY-FIVE. 8½x11. 48 pages. Caterpillar Tractor Co., Peoria, Ill. Description in detail of this new Caterpillar model.

Business Notes

CALCIUM CHLORIDE ASSOCIATION has moved its offices to 2075 Penobscot Building, Detroit, Mich. During the past year B. C. Tiney has been named chief engineer of the association and Fred Burggraf has been appointed soils engineer.

NORTHERN BRIDGE CO., Chicago, Ill., has purchased the lands, buildings, tools and equipment of the Kelly-Atkinson Construction Co. Edward J. Hughes is president and treasurer and William J. Howard is vice-president and secretary of the Northern Bridge Co.

AMERICAN SEALDROK CORP. is the name of a newly incorporated unit of the AMERICAN ASPHALT PAINT CO. The new company will handle a process for the treatment of mineral aggregate involving a new waterproofing process for mineral aggregate in which the aggregate is impregnated with an asphalt solution. The new company will be located at 43 East Ohio St., Chicago, Ill.

REVERE COPPER & BRASS INC., New York City, announces that J. A. Doucett has been appointed vice-president in charge of sales, and C. A. Macfie has been made general sales manager.

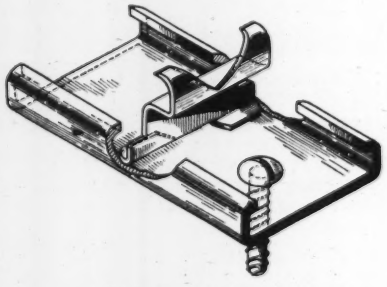
MISSOURI VALLEY BRIDGE & IRON CO., Leavenworth, Kan., announces that W. H. Bosier has rejoined their organization and is now in charge of the Southwestern office at Dallas, Texas.

INGERSOLL-RAND CO., Phillipsburg, N. J., has acquired the turbo-blower business of the General Electric Co. and will consolidate it with its own turbo-blower department. The manufacturing equipment previously employed by General Electric is being moved to Ingersoll-Rand's Phillipsburg plant. Sales activities will be directed from Ingersoll-Rand's general offices at 11 Broadway, New York City.

Clips for Floor Laying Eliminates Nails and Sleepers

A new mechanical method for laying ordinary strip wood flooring without the use of nails, wood sleepers or mastic, has been introduced by Knapp Bros. Mfg. Co., Chicago, Ill. It is known as the Loxit system.

A metal channel $1\frac{1}{4} \times \frac{3}{16}$ in. with overlapping top edges is used instead of wood sleepers. This channel is laid over the sub-floor in the same general manner as wood sleepers. The wood flooring is laid in the same way that a nailed floor would be laid, but instead of using nails to fasten



Loxit tongue and groove clip

the flooring, a metal clip is used. These clips are slipped into the channels immediately ahead of the last board placed and are driven into place by driving up the next board. This operation forces the clips to bite into and over the top of one board and into the groove of another, locking both boards together into the channel. The tongues of the clips are slotted so that they may adjust themselves easily to the tongue and groove of the flooring. They are made slightly wider at the bottom than the channels, to assure a tight gripping contact.